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Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category. Volume 2--Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory

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for

PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, and PRETREATMENT STANDARDS

for the

IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY

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SECTION I

PREFACE

The USEPA is proposing effluent limitations and standards for the steel industry. The proposed regulation contains effluent limitations for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT) as well as pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards (NSPS), pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act.

This part of the Development Document highlights the technical aspects of EPA's study of the Cokemaking Subcategory of the Iron and Steel Industry. Volume I of the Development Document discusses issues pertaining to the industry in general, while other volumes pertain to the subcategories of the industry.

COKEMAKING SUBCATEGORY

SECTION II

CONCLUSIONS

This volume highlights the technical aspects of EPA's study of the Cokemaking Subcategory of the Iron and Steel Manufacturing Category.

Based upon this study and a review of previous studies by EPA, the Agency has reached the following conclusions:

1. The Agency is retaining the previous subcategorization of cokemaking operations into by-product and beehive cokemaking based on the differences in the respective manufacturing processes. The Agency also retained subdivision of the by-product cokemaking subcategory into biological and physical/chemical treatment methods at both the BPT and BAT levels of treatment.

2. For the most part, the originally promulgated BPT limitations (1974) are practicable and achievable by all coke plants. In fact, data obtained by the Agency since that time shows that the previous limitations for by-product coke plants are more lenient than could be justified for all pollutants except total suspended solids. Nonetheless, except for total suspended solids (TSS), these proposed BPT limitations are the same as those previously promulgated. For beehive operations, the previously promulgated BPT limitation of no discharge of pollutants remains justified, and is the proposed BPT limitation.

3. Sampling and analysis of by-product coke plant wastewaters revealed high concentrations of more than 40 toxic pollutants. Cokemaking operations generate more of these toxic pollutants than any industrial category examined by EPA. The discharge of these toxic pollutants can, however, be significantly reduced by industry compliance with the proposed BPT and BAT limitations as shown below:

	Effluent Loadings (Tons/Yr)		
	Raw Waste	Proposed BPT	Proposed BAT
Flow, MGD	36.9	49.0	34.1
TSS	2,807	5,915	1,037
Oil and Grease	4,211	1,120	271
Ammonia (N)	33,690	7,514	861
Total Cyanide	2,807	2,240	171
Phenolic Compounds	16,845	40	3.6
Toxic Organics	6,654	309	37.2
Toxic Metals	152	58.2	23.8
Other Pollutants	35,374	1,158	738

4. EPA estimates that, as of January 1, 1978, the investment and annual costs to achieve the proposed BPT and BAT limitations for the Cokemaking subcategory are as follows:

	Investment Costs			
	Total	In-Place	Required	Annual Costs
BPT	303	178	125	105
BAT	57	12	45	9
TOTAL	360	190	170	114

All costs are in millions of July 1, 1978 dollars. No additional capital investment for beehive operations is anticipated, since the remaining active plants achieve no discharge. Annual operating costs for beehive wastewater treatment is less than $60,000 per year.

5. The Agency has evaluated the "cost/reasonableness" of controlling discharges of the conventional pollutants, TSS and oil and grease, and concludes that the control costs of these pollutants, based on the BCT model treatment systems are less than the costs experienced by publicly owned treatment works (POTWs). Therefore, EPA is proposing BCT limitations for TSS and oil and grease. For beehive operations, both the proposed BPT and proposed BCT limitations are zero discharge.

6. With regard to the Third Circuit's "remand issues", the Agency concludes that:

   a. The Court ruled that the NSPS flow of 100 gal/ton was "not demonstrated" and therefore, remanded that issue to the Agency for reconsideration. Since this flow rate also applies to the model BAT treatment system, the Agency reexamined the issue with respect to the proposed BAT limitations as well. In addition to the four plants surveyed in the original study by the Agency, other plants have demonstrated process wastewater flows of 100 GPT or less, including two of the five participants in the toxic pollutant sampling phase of this study. In addition, 24% of all plants reported process flows of less than 100 gal/ton in response to questionnaires. However, due to an increasing trend toward additional by-product recovery and air pollution emission controls which will be required by the time the proposed BAT limitations must be achieved, the Agency increased the model flow used to establish the proposed BAT limitations and to estimate the cost of complying with those limitations to 153 gal/ton.

   b. The 175 gal/ton model discharge flow for the proposed BPT limitations is demonstrated and, in fact, is less stringent than might otherwise be justified. The increased data base now available shows that 47% of the by-product coke plants discharge less than 175 gpt and 80% of the plants have an average flow of 173 gpt.

c. The previously promulgated BPT limitations for ammonia-N (NH3-N) are appropriate and the Agency is proposing BPT limitations which are identical. All five of the sampled plants using the free and fixed ammonia removal stills described in the BPT model treatment system achieved the previously promulgated BPT limitations for ammonia-N.

d. The components of the BAT model treatment systems are currently used by existing coke plants and achieve the proposed limitations. Multi-step biological treatment is practiced by plant 0868A, and other treatment systems are designed to provide for such operation. Recycle of barometric condenser water, with less than 4% blowdown is practiced at plants 0112D, 0448A and 0856F, and the latter two plants achieve blowdown flows of 3 gallons per ton or less. Filtration of effluent prior to discharge is practiced at plants 0684F and 0856A.

7. Although a significant number of toxic pollutants have been identified in the raw wastewaters from by-product cokemaking operations, it is not necessary to propose limitations for each toxic pollutant detected. Adequate coverage of toxic pollutants is attained by controlling two currently limited pollutants (cyanides and phenolic compounds) and adding limitations for benzene, naphthalene, and benzo(a)pyrene. Phenolic compounds accurately represent acid extractable toxic organic pollutants. Benzene has been selected to represent total volatile organic pollutants, while naphthalene and benzo(a)pyrene are practical examples of base/neutral extractables. By limiting the discharge of these toxic pollutants, effective control is provided for all such pollutants identified in raw cokemaking wastewaters.

8. The Agency is proposing separate BAT limitations for those existing sources which have full scale physical/chemical (activated carbon) BAT treatment systems.

9. Table II-1 presents the treatment model flow and effluent quality data used to develop the proposed BPT effluent limitations for the cokemaking subcategory, and Table II-2 presents these proposed limitations. Table II-3 presents the treatment model flow and effluent quality data used to develop the proposed BAT and BCT effluent limitations and the proposed NSPS, PSES, and PSNS for the cokemaking subcategory; Table II-4 presents these proposed limitations and standards.

TABLE II-1

BPT TREATMENT MODEL FLOWS AND EFFLUENT QUALITY
COKEMAKING SUBCATEGORY

		Monthly Average Concentrations(1)	
	Pollutant	By-Product Cokemaking Operations	Beehive Cokemaking Operations
	Flow, gal/ton	175(2)	0
	TSS	100	-
	O&G	15	-
	Ammonia-N	125	-
121	Total Cyanide	30	-
	Phenolics (4AAP)	2	-
	pH, Units	6.0 to 9.0	-

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(1): Concentrations are expresed as mg/l unless otherwise noted. Maximum daily concentrations are three times the monthly average concentrations presented above.

(2): Additional effluent flows are necessary as follows:
For indirect ammonia recovery systems - 50 gal/ton
For qualifying wet desulfurizer systems - 25 gal/ton

TABLE II-2

PROPOSED BPT EFFLUENT LIMITATIONS COKEMAKING SUBCATEGORY

	Monthly Average Effluent Limitations(1) (Kg/Kkg of Coke Produced)	
Pollutant	By-Product Cokemaking Operations(2)	Beehive Cokemaking Operations
TSS	0.0750	There shall be no discharge of process wastewater pollutants to navigable waters.
O&G	0.0109	
Ammonia-N	0.0912	
121 Total Cyanide	0.0219	
Phenolics (4AAP)	0.0015	
pH, Units	Within the range 6.0 to 9.0	

---

(1): Maximum daily limitations are three times monthly average limitations presented above.

(2): Additional load allowances are provided for the following operations. Multiply the limitations given above by the appropriate factor:
- For indirect ammonia recovery systems, multiply by 1.3
- For qualifying wet desulfurizer systems, multiply by 1.15
- For indirect ammonia and qualifying wet desulfurizing, multiply by 1.45

TABLE II-3

TREATMENT MODEL FLOWS AND PERFORMANCE STANDARDS
COKEMAKING SUBCATEGORY

		Monthly Average Concentrations(1)				
	Pollutant	BAT	BCT	NSPS	PSES	PSNS
	Flow, gal/ton	153(2)	153(2)	153	153(2)	153
	TSS	-	20	20	-	-
	O&G	-	10*	10*	-	-
	Ammonia-N	15(3)	-	15	15(3)	15
121	Total Cyanide	2.5(3)	-	2.5	2.5(3)	2.5
	Phenolics (4AAP)	0.025(3)	-	0.025	0.025(3)	0.025
004	Benzene	0.05	-	0.05	0.05	0.05
055	Naphthalene	0.01	-	0.01	0.01	0.01
073	Benzo(a)pyrene	0.02	-	0.02	0.02	0.02
	pH, Units	-	6.0 to 9.0	6.0 to 9.0	-	-

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(1): Concentrations are expressed as mg/l unless otherwise noted, and apply only to by-product cokemaking operations. For beehive operations, effluent flows are eliminated through the use of total recylces systems as at the BPT level. Maximum daily concentrations are based upon multiplying the monthly average concentrations presented above by the following factors:

Pollutant(s)	Factor
TSS	2.67
Total Cyanide, Benzene, Naphthalene & Benzo(a)pyrene	2.0
Phenolics (4AAP)	4.0
Ammonia-N - Biological treatment systems	5.34
Ammonia-N - Physical-Chemical treatment systems	2.0

(2): For physical-chemical treatment systems, the flow basis is 103 gal/ton. Additional effluent flow for indirect ammonia recovery (50 gal/ton) and wet desulfurizers (25 gal/ton) apply to all plants with such systems.

(3): For physical-chemical treatment systems, the Ammonia-N concentration is 60 mg/l, the phenolics (4AAP) concentration is 0.05 mg/l, and the total cyanide concentration does not apply.

* : As shown, daily maximum concentration only.

TABLE II-4

PROPOSED EFFLUENT LIMITATIONS AND STANDARDS
COKEMAKING SUBCATEGORY

		Monthly Average Effluent Limitations and Standards$^{(1)}$ Kg/Kkg of Coke Produced							
	Pollutant	BAT$^{(2)}$		BCT$^{(2)}$		NSPS	PSES$^{(2)}$		PSNS
		Bio	P/C	Bio	P/C		Bio	P/C	
	TSS	-	-	1280	859	1280	-	-	-
	O&G	-	-	638*	430*	638*	-	-	-
	Ammonia-N	957	2580	-	-	957	957	2580	957
121	Total Cyanide	160	-	-	-	160	160	-	160
	Phenolics (4AAP)	1.60	2.15	-	-	1.60	1.60	2.15	1.60
004	Benzene	3.19	2.15	-	-	3.19	3.19	2.15	3.19
055	Naphthalene	0.64	0.43	-	-	0.64	0.64	0.43	0.64
073	Benzo(a)pyrene	1.28	0.86	-	-	1.28	1.28	0.86	1.28
	pH, Units	-	-	6.0 to 9.0		6.0 to 9.0			-

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(1): The proposed limitations and standards have been multiplied by 10^5 to obtain the values presented in this table. Maximum daily limitations are based upon multiplying the above monthly average limitations and standards by the following factors:

Pollutant	Factor
TSS	2.67
Total Cyanide, Benzene, Naphthalene & Benzo(a)pyrene	2.0
Phenolics (4AAP)	4.0
Ammonia-N, for biological treatment systems	5.34
Ammonia-N, for physical-chemical treatment systems	2.0

For beehive operations, there shall be no discharge of process wastewater pollutants to navigable waters.

(2): For plants with indirect ammonia recovery or qualifying wet desufurizers, the basic limits are multiplied by the following factors:

	Biological Systems	Physical-Chemical Systems
Indirect Ammonia Recovery	1.33	1.5
Wet Desulfurizers	1.16	1.25

* : As shown, daily maximum limitation or standard only.

COKEMAKING SUBCATEGORY

SECTION III

INTRODUCTION

General Discussion

Cokemaking operations include by-product recovery and beehive facilities. Nearly all of the metallurgical coke produced in the United States is made in by-product recovery coke ovens which operate as part of integrated steel mill complexes. By-product recovery faciliities are also employed by merchant coke manufacturers, sometimes as part of a chemical or utility plant operation. A very small portion is still made in non-recovery type ovens with arched roofs that closely resemble old- fasioned beehives, hence the name beehive cokemaking operations.

Both types of cokemaking facilities are capable of producing high quality metallurgical coke for use in blast furnaces or in foundry cupolas. But only the by-product recovery coke ovens are equipped to produce a wide variety of other products in addition to coke. Further details on each process and the respective pollutant loads are presented in subsequent discussions.

Limitations governing cokemaking were previously promulgated in 1974 for the following pollutants: Total suspended solids; oil and grease; phenolic compounds; ammonia, total cyanide and pH at the BPT level; total suspended solids; oil and grease; phenolic compounds; ammonia; cyanide amenable to chlorination; sulfide and pH at the BAT and NSPS levels. For the current study, the Agency conducted additional sampling and gathered more detailed information to provide an expanded data base.

Data Collection Activities

In addition to evaluating data from previous studies, EPA issued Data Collection Portfolios (DCPs) to all by-product cokemaking facilities known to be active at the time questionnaires were distributed. Responses were received from all facilities. Since that time, three other small independent plants have been reported producing coke, and three of the original respondents have closed permanently. There are currently 59 by-product cokemaking plants and two beehive cokemaking plants in operation. The DCPs distributed to the by-product coke plants requested information on production processes and rates, process water usage and discharge rates, wastewater treatment and disposal methods, age of plants (first year of on-site production and dates of rebuilds), age of treatment systems, and location.

The Agency did not seek any additional data regarding beehive operations. The previously promulgated BPT limitations required no discharge of process wastewater pollutants, and the Agency did not receive any comments from industry during the rulemaking process which questioned the appropriateness of that limitation.

Based upon DCP responses and other information, EPA issued Detailed Data Collection Portfolios (D-DCPs) to nine by-product coke plants. These D-DCPs focused upon obtaining data on costs and wasteloads.

In addition to the questionnaire responses, the Agency reviewed its sampling data from prior studies of four coke plants, and sampled five additional plants for this study. The Agency also performed sampling and analyses as described in Volume I.

As shown in Table III-1, the expanded data base for by-product cokemaking includes EPA sampling at nine plants (15% of plants; representing 22% of industry capacity), DCP responses from 59 plants (95% of plants; and 99% of capacity) and D-DCP responses from nine plants (15% of the plants; representing 17% of capacity). A list of beehive operations is provided in Table III-2, but only one plant with two batteries of ovens is known to be active.

Cokemaking via the By-Product Recovery Process

The production of metallurgical coke is an essential part of the steel industry, since it provides one of the basic raw materials necessary for the operation of ironmaking blast furnaces. Of the two traditional processes for the manufacture of coke, by-product recovery ovens have virtually eclipsed the beehive ovens in commercial applications. Less than 1% of the metallurgical coke produced in 1978 was made in beehive ovens. The remaining 99+% of coke production came from coke plants practicing varying degrees of by-product recovery (64 plants at 59 locations, some with 2 or 3 plants per location, in 17 different states).

The by-product recovery process, as the name implies, not only produces high-quality coke for use as blast furnace or foundry fuels and carbon sources, but also provides a means of recovering valuable by-products of the distillation reaction. During this process, air is excluded from the coking chambers, while heat is supplied from the external combustion of fuel gases in flues located within dividing walls separating adjacent ovens.

The volatile components are recovered from the gas stream and processed in a wide variety of ways to produce tars, light oils, phenolates, ammonium compounds, naphthalene, and other materials of value, including the coke oven gas itself. Table III-3 summarizes by-product recovery processes in use at the 59 locations where such cokemaking operations exist in the United States. Note that all plants recover coke oven gas and crude coal tars, and a majority also produce crude light oils, ammonium compounds and naphthalene. Of the remaining 22 products, six are produced by only one by-product recovery plant. With one exception, no single plant recovers more than 12 of the 27 products listed.

Beehive cokemaking represents a distinctly different approach to the production of metallurgical coke from the more widely used by-products recovery process.

In the beehive process, air is admitted to the oven during the coking cycle so the volatile products which distill from the coal are immediately burned. A very small percentage of these products is transferred to the water used to cool the coke (quench) and no other water-borne pollutants are generated during the process. For additional details on wastewater characterization and its impact on subcategorization, refer to Sections IV and V.

A by-product recovery coke plant consists of batteries of ovens in which coking coals are heated out of contact with air to drive off volatile components of the coal. The coal used is usually a blend of high, medium and low volatile bituminous grades selected because of specific coking characteristics. The volatiles are drawn off and recovered as by-products during the process. The residue remaining in the oven is the coke product. Typical coking time is 18 hours. The ovens themselves are narrow, rectangular, silica brick chambers arranged side by side in groups of 20 to 90, most often in batteries of 50 to 70 individual ovens. The smallest plants in the industry have a single battery, while the largest has up to 20 batteries with 60-70 ovens in each battery. Most conventional ovens in use today are of similar size, typically 12 meters long, 4.5 meters high, and 0.45 meters wide (approximately 13 x 5 x 0.5 yards). However, new ovens in service and under construction at several American coke plants have increased in size to 15 meters long, 6 meters high and 0.6 meters wide (approximately 16.4 x 6.6 x 0.66 yards). These larger ovens can accomodate more than twice the coal charges of the smaller ovens, thus producing more coke per charge, and reducing the potential for air emissions while charging and pushing. Additionally, the change in oven design provides the opportunity to install certain other technological improvements including preheating of incoming coal in enclosed chambers; pipeline charging systems using pulverized coal (thus eliminating the need for opening lids atop the ovens while charging and leveling the charge); and the installation of ductwork and shed-type enclosures to capture and clean charging and pushing emissions. Such emission control practices have provided significant improvement in air quality around by-products coke plants. However, these and other similar improvements increase the polluted wastewater load and volume by transferring the air emissions into waters used for scrubbing. For additional discussion on the processes involved in cokemaking in by-product recovery ovens, refer to pages 31-36 in the previous study.

In addition to increases in size of by-product coke ovens, the Agency has noted several trends within this subcategory since the study which formed the basis of the originally promulgated limitations was completed. Fewer plants (less than 7% of cokemaking capacity) employ the indirect ammonia recovery process than formerly, and the recovery and refining of light oils to benzene, toluene and xylene is less common than previously practiced. On the other hand, more plants today practice some form of desulfurization of coke oven gas, thereby allowing for wider use of the by-product gas as fuel for other steel plant operations. New techniques for gas desulfurization and subsequent recovery of sulfur values involve two processes which have been developed by the Japanese industry and installed on some new American coke batteries. Hydrogen sulfides are absorbed using ammonia from coke oven gas together with catalysts in a scrubbing solution. The sulfur laden solution is then processed into a liquid ammonium sulfate slurry which can be used in fertilizer production or in chemical processes.

The application of required air pollution controls in areas where they were not formerly used is a relatively recent development in cokemaking. For example, the problems associated with noxious emissions from the charging of coal into hot ovens have been addressed on new or rehabilitated ovens by installing pipeline charging of preheated coals, or by equipping larry cars (charging machines) with emission collection and scrubbing systems. The former practice may employ exhaust scrubbers on each of the preheaters, while the larry car systems generate considerable volumes of highly contaminated wastewaters which require disposal. In some cases, coke pushing emissions are now being controlled by emission collectors and scrubbers, either on enclosed quench cars or in the form of shed enclosures. These latter structures are enormous collectors of dust-laden gas, some as large as 114 meters long, 18 meters wide and 27 meters high (374 x 60 x 90 feet). At some plants wastewaters blown down from either system are currently used as makeup water for coke quenching, but this practice may be subject to air pollution control regulations which could affect its continued use. Wet scrubber systems are also in use at coke screening stations and coal preparation, handling and storage areas within the boundaries of a coke plant. All of these systems represent wastewater sources which are new to by-product cokemaking operations, having been installed only within the last few years. More specific details relating to wastewater flows and characteristics are provided in Section V. Process flow diagrams for by-product recovery and light oil refining are shown on Figures III-1 and III-2.

An overall general summary of the by-product cokemaking operations and practices in the United States is provided in Table III-4. Essential data on age, size, wastewater flow, by-product recovery, wastewater control and treatment technology, and ultimate disposal of wastewaters are highlighted for each by-product coke plant. Note in particular the large differences between plants with respect to size, wastewater flows, and discharge modes. A significant number of coke plants discharge all or part of their wastewaters to local publicly owned treatment works (POTWs) for final treatment following limited pretreatment on-site. Others continue to dispose of a portion or all of their wastewaters by coke quenching with concomitant adverse air quality impacts. Additional discussion on wastewater flow and disposal follows in Sections V and IX.

Cokemaking By the Beehive Oven Process

This older cokemaking process accounts for less than 1% of the metallurgical coke produced in the United States. Inherent in the beehive process is the significant atmospheric emissions of components of the coal charged to the ovens. With the increased efforts to minimize air pollution nationwide, the use of this operation will continue to decline, since control of emissions places severe constraints on oven operation, making it more difficult to compete on an economical basis with the by-product recovery processes. Refer to EPA-440/I-024a, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steelmaking Segment of the Iron and Steel Manufacturing Point Source Category, dated June 1974, Page 36 et seq, for more information on the beehive process. Process flow diagrams for beehive plant operations are shown on Figures III-3 and III-4. Figure III-3 shows a simpler system utilizing quenching within the oven, while Figure III-4 illustrates an external quenching arrangement at a modern plant.

TABLE III-1

BY-PRODUCT COKEMAKING DATA BASE

	No. of Plants	% of Total No. of Plants	Rated Annual Capacity Reported by Plants (Tons/Year)	% of Total Annual Capacity
Plants Sampled for Dev. Doc. - 6/74	4	6.4	9,427,220	12.1
Plants Sampled for This Study	5	8.1	7,312,045	9.4
Total Plants Sampled	9	14.5	16,739,265	21.5
Plants Surveyed Via Detailed DCP	9 incl. 3 above	14.5 incl. 4.8 above	13,198,765 incl. 6,576,570 above	16.9 incl. 8.4 above
Plants Sampled and/or Solicited via Detailed DCP	15	24.2	23,361,460	30.0
Plants Responding to Basic DCP	59(1)	95.2	77,445,700	99.4
Total Plants in Subcategory	62(2)	100.0	77,887,350	100.0

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(1) Three of the original respondents have closed permanently.

(2) Current data base covers 59 active plants. DCP responses are on hand from 56 of these, whose capacity is 75,547,700 tons per year, or 99.4% of present capacity.

TABLE III-2

MAJOR BEEHIVE COKEMAKING OPERATIONS

Plant	Location	No. of Ovens	Status
New York Mining and Manufacturing Company	Calvert, KY	200	Inactive
Sharon Steel, Carpentertown Coal and Coke	Templeton, PA	264	Deactivated Permanently (Sampled in 1973)
Hillman Coal and Coke	Alicia, PA	400	Inactive, and probably dismantled
Rochester and Pittsburgh Coke Company	Lucerne, PA	262	Inactive
Jewell Smokeless Coal Corporation	Vansant, VA	210	Intermittently Active (Sampled in 1973 at two sites.)

NOTE: Active/inactive status of beehive operations varies from month to month. As a result, capacities and production-related data are unavailable.

TABLE III-3

COAL CHEMICALS PRODUCED AT BY-PRODUCT RECOVERY PLANTS

Material Recovered	No. of Plants Practicing Recovery	Percent Practicing Recovery % of No.	 % of Coke Prod.
Coke Oven Gas	59	100.0	100.0
Crude Coal Tar	59	100.0	100.0
Crude Light Oils	48	81.4	90.2
Ammonium Sulfate	43	72.9	78.4
Naphthalene Solidifying at <74°C	41	69.5	76.2
Sodium Phenolate (or Carbolates)	25	42.4	46.8
Intermediate Light Oils	20	33.9	43.7
Toluene, all grades	10	16.9	30.4
Benzene, specification grades	9	15.3	27.9
Xylene, all grades	9	15.3	27.3
Solvent Naphtha, all grades	8	13.6	24.4
Elemental Sulfur	8	13.6	22.3
Crude Chemical Oil (Tar Acid Oils)	8	13.6	20.1
Naphthalene solidifying between 74°C and 79°C	4	6.8	22.4
Soft Pitch of Tar	4	6.8	21.0
Enriched Ammonia Liquor	4	6.8	6.5
Benzene, non-specification grades	3	5.1	5.1
Creosote Oils, straight distillate	3	5.1	19.7
Phenol, non-industrial grades	3	5.1	17.2
Hard Pitch of Tar	2	3.4	14.7
Creosote Oils in coal tar solution	2	3.4	11.8
Cresols	1	1.7	9.8
Cresylic Acid	1	1.7	9.8
Picolines	1	1.7	9.8
Anhydrous Ammonia	1	1.7	9.8
Phenol, industrial grades	1	1.7	9.8
Mono- and Diammonium Phosphates	1	1.7	2.0

TABLE III-4

GENERAL SUMMARY TABLE - BY-PRODUCT COKEMAKING

Plant Code No.	First Year Prod.	Rebuild Active Batteries		Production, TPD		Typical Raw(1) Waste Flow		Operations		By-Products				Control & Treatment Tech.						In vs. Ret	Discharge Mode With Typical GPT for each			
		Oldest	Newest	Rated Capa-city	Typical	GPD	GPT	NH3	DS. GPT	APT	ØOH	BTX	OTH	ASF	ASL or ASC	DP	Oxidation CH	Oxidation Bio	CA		Direct	POTW	Quench	Other
0012A	1920	1941	1968	2400	2140	438,700	205	I	N	APS	N	C		Y	ASC	N		BOA2		Ret	107	0	98	
0012B	1919	1966	1967	1225	1225	107,800	88	I	N	APS	N	R	(2)	Y	ASC	N	(3)	BOA2		Ret	88	0	0	
0024A	1916	1953	1967	3480	2100	1,944,000	926	2	D	APH	Y	C		Y	ASL	Y				Ret	0	253	673	
0024B	1901	1968	1968	2150	2000	370,000	185	N	N	N	N	N		N	N	N				Ret	0	0	142	43(DW)
0060	1953	1953	1977	5150	4890	780,600	160	I	D	APS	Y	R	(2)	Y	ASL	Y				Ret	0	160	0	
0060A	1928	1959	1969	1930	1811	119,500	66	I	D	APS	Y	R	(2)(5)	Y	ASL	Y		BOA1		Ret	66	0	0	
0060F	1943	1943	1953	1045	840	37,000	44	N	N	N	N	N		N	N	N				In	0	0	0	44(4)
0112	1914	1941	1976	5840	5058	840,000	166	I	D	APS	N	C	(2)(5)	N	ASL	N		BOA1		Ret	104	0	122	
0112A	1920	1941	1961	9800	9163	1,540,000	168	I	D	APS	N	R	(2)(5)	N	ASL	N		BOA1		Ret	0	168	0	
0112B	1924	1948	1970	8140	6908	712,000	103	I	I	APS	Y	R	(2)(5)	Y	ASL	Y				In	0	0	47	70(ES)
0112C (R)	1921	1965	1965	1100	998	61,000	61	I	N	APS	Y	C	(2)	N	ASL	N		BOA1		Ret	0	0	61	
0112C (F)	1926	1948	1952	3500	3028	487,500	161	I	N	APS	Y	C	(2)	Y	ASL	N		BOA1		Ret	0	0	161	
0112D	1969	1969	1972	6670	5179	488,000	94	I	D	APS	N	N	(2)(5)	N	N	N				In	0	0	51	43(DW)
0196A	1918	1960	1974	*	*	*	*	I	N	APS	N	R	(2)	I	N	N				In	*	*	*	*
0212	1909	1926	1946	1086	1002	256,500	256	N	D	N	N	N		N	N	N				In	0	256	0	
0248A	1912	1948	1951	1200	1050	134,500	128	I	N	APS	Y	R		Y	ASC	Y				Ret	0	136	0	
0256E	1964	1964	1964	1145	1145	267,000	233	N	N	N	Y	C		N	N	N				No Trt	94	0	139	
0272	1919	1942	1968	3004	3004	312,500	104	I	D	APS	Y	C	(2)	Y	ASL	Y				Ret	43	0	69	
0280B	1929	1929	1963	940	880	173,500	197	I	D	N	N	N	(2)	I	I	N				Ret	0	82	115	
0304	1926	1950	1958	360	Unk	Unk	Unk	I	N	APS	N	N		Y	ASL	N				In	Unk	0	Unk	
0320	1962	1962	1972	4340	3945	1,152,000	292	I	N	APP	N	C	(2)	Y	ASL	N				In	0	292	0	
0348A	1914	1952	1976	1000	800	28,800	36	I	N	N	N	N		Y	N	N				In	0	0	0	36(4)
0380	1919	1973	1973	400	340	Unk	Unk	I	D	APS	Y	N	(2)	Y	ASL	Y				In	Unk	Unk	0	
0384A -2-	1913	1950	1970	6170	5640	908,000	161	I	N	APS	Y	C	(2)	Y	ASL	Y				In	0	51	110	
0364A -3-	1943	1974	1974	2500	1562	354,600	227	I	D	APS	Y	C	(2)(5)	Y	ASL	Y				In	0	147	92	
0384A -4-	1978	1978	1978	3014	2740	Unk	Unk	I	D	APS	Y	C	(2)(5)	Y	ASL	Y				In	0	Unk	Unk	
0396A	1906	1955	1955	1740	1560	511,000	350	I	N	APS	N	C	(2)	N	N	N	(6)			Ret	0	350	0	
0396C	1906	1953	1953	814	702	979,300	1395	I	N	APS	N	R	(2)	N	N	N				No Trt	0	1395	0	
0402	1917	1917	1955	*	*	*	*	2	D	APH	Y	R		Y	ASL	Y		BOA1		Ret	*	*	*	
0426	1920	1920	1958	2760	2400	962,400	401	I	N	APS	N	C	(2)	Y	ASL	N		BOA1		Ret	417	0	0	
0432A	1926	1945	1976	6946	4504	712,000	158	I	N	APS	N	R	(2)	Y	I	N				In	0	0	158	
0432B	1919	1953	1961	5300	5230	502,000	96	I	N	APS	Y	C	(2)	Y	I	Y				Ret	96	0	0	
0448A	1942	1943	1959	4100	3800	201,400	53	I	N	APS APP	N	C	(2)	Y	I	I				Ret	0	0	53	
0464B	1918	1918	1918	530	500	410,000	820	2	N	APH	N	N		Y	N	N				In	0	820	0	
0464C	1925	1942	1952	625	600	19,800	33	N	N	N	Y	N		N	N	Y	CLA			Ret	0	33	0	
0464E	1914	1925	1970	2047	1272	496,000	390	2	N	APH	N	C		Y	ASL	N		BOA1		Ret	236	0	170	

TABLE III-4
GENERAL SUMMARY
BY-PRODUCT COKEMAKING
PAGE 2

Plant Code No.	First Year Prod.	Rebuild Active Batteries Oldest	Rebuild Active Batteries Newest	Production, TPD Rated Capa-city	Production, TPD Typical	Typical Raw(1) Waste Flow GPD	Typical Raw(1) Waste Flow GPT	Operations NH3	Operations DS. GPT	By-Products APT	By-Products ØOH	By-Products BTX	OTH	Control & Treatment Tech. ASF	ASL or ASC	DP	Oxidation CH	Oxidation Bio	CA	In vs. Ret	Discharge Mode With Typical GPT for each Direct	POTW	Quench	Other
0492A	1944	1944	1944	1214	690	40,000	58	1	N	APS	N	R	(2)	Y	I	N				Ret	58	0	0	
0538A	1929	1972	1972	450	400	Unk	Unk	1	N	APS	N	C	(2)	Y	ASL	N				In	Unk	0	Unk	
0584B -2-	1953	1953	1957	2500	2500	Unk	Unk	1	840	APS	Y	C	(2)	Y	I	Y				In	Unk	0	Unk	
0584B -3-	1970	1970	1970	2900	2700	Unk	Unk	1	53	APS	Y	C	(2)	Y	I	Y				In	Unk	0	Unk	
0584C	Pre- 1921	1942	1961	2600	1743	75,000	43	1	N	APS	N	C	(2)	Y	ASL	N				In	0	0	51	
0584F (B)	1973	1973	1973	3600	3000	660,000	220	1	D	APS	N	C	(2)(5)	Y	ASC	N		BOA2		In	237	0	0	
0584F (M)	1923	1947	1956	4500	4066	775,000	191	1	N	APS	I	C	(2)	Y	ASC	I		BOA2		Ret	78	0	130	
0656A	1906	1916	1916	800	725	150,500	208	N	N	N	N	N		N	N	N				No Trt	0	111	97	
0684A (8)	1950	1950	1952	2970	2735	244,0900	89	1	N	APS	N	R	(2)	N	N	N				No Trt	0	0	89	
0684B	1923	1948	1949	1852	1279	331,200	259	1	N	APS	N	C	(2)	I	I	N				In	113	0	146	
0684D	1927	1955	1955	576	500	119,500	239	1	N	APS	N	C	(2)	I	I	N				Ret	0	0	0	239(7)
0684F -1-	1917	1943	1977	2782	2049	184,100	90	1	N	APS	Y	R	(2)	Y	ASC	Y			CAG	Ret	46	0	49	
0684F -2-	1952	1952	1952	1954	1286	59,360	46	1	N	APS	Y	R	(2)	Y	ASC	Y			CAG	Ret	28	0	21	
0684H	1943	1943	1943	1369	1300	542,000	417	1	N	APS	Y	C	(2)	Y	ASL	Y				In	0	433	0	
0684I	1918	1942	1965	2372	1785	371,300	208	1	N	APS	N	C	(2)	Y	ASL	N		BOA1		Ret	218	0	0	
0684J	1914	1952	1952	1066	560	377,500	674	1	N	APS	N	C	(2)	Y	ASL	N				Ret	694	0	0	
0724F (8)	1920	1920	1920	650	560	318,000	568	1	N	APS	Y	C		Y	ASL	Y				Ret	584	0	0	
0732A	1929	1950	1958	2025	1410	323,000	229	1	D	ASP	Y	C		Y	ASL	Y	CLA		CAG	Ret	147	0	82	
0810	1917	1962	1962	*	*	*	*	2	D	APH	Y	C		Y	N	Y		BOA1			Ret	*	*	*
0856A	1918	1948	1977	20780	16,342	2,321,000	142	1	D	APO(9)	Y	R	(2)(5)	Y	ASL	Y		BOA1		Ret	281	0	0	
0856F	1952	1952	2953	3000	3000	261,000	87	1	N	APS	Y	C	(2)	Y	ASL	Y				In	43	0	52	
0856N	1917	1947	1957	4468	4319	450,000	104	1	N	APS	N	C		I	I	I				Ret	0	0	104	
0860A (8)	1915	1950	1952	1580	1262	339,500	269	1	N	APS	N	N		Y	N	N				Ret	166	0	103	
0860B	1911	1949	1976	11960	9750	1,716,000	176	1	N	APS	N	C	(2)	N	N	N				In	0	19	157	
0864A	1944	1944	1944	3558	3520	514,000	146	1	N	APS	N	R	(2)	Y	ASL	I				In	0	0	153	
0868A	1912	1958	1979	6866	5930	576,000	97	1	N	APS	N	C	(2)	Y	ASL	Y		BOA2		In	146	0	0	
0920B	1942	1942	1956	1836	1332	80,000	60	1	N	APS	Y	C	(2)	Y	ASL	Y				Ret	60	0	0	
0920F	1917	1940	1976	5205	4310	590,000	137	1	N	APS	Y	C		Y	ASC	I		BOA 1 or 2		Ret	137	0	0	
0946A	1919	1968	1968	1000	700	238,000	340	1	N	APS	N	C		N	N	N				No Trt	0	340	0	
0948A	1916	1954	1958	3816	3483	469,440	135	1	N	APS	Y	C	(2)	I	I	Y				In	0	0	135	
0948C	1919	1952	1961	4000	3406	248,600	73	2	N	APH	Y	C	(2)	Y	ASL	Y				In	0	91	0	

TABLE III-4
GENERAL SUMMARY
BY-PRODUCT COKEMAKING
PAGE 3

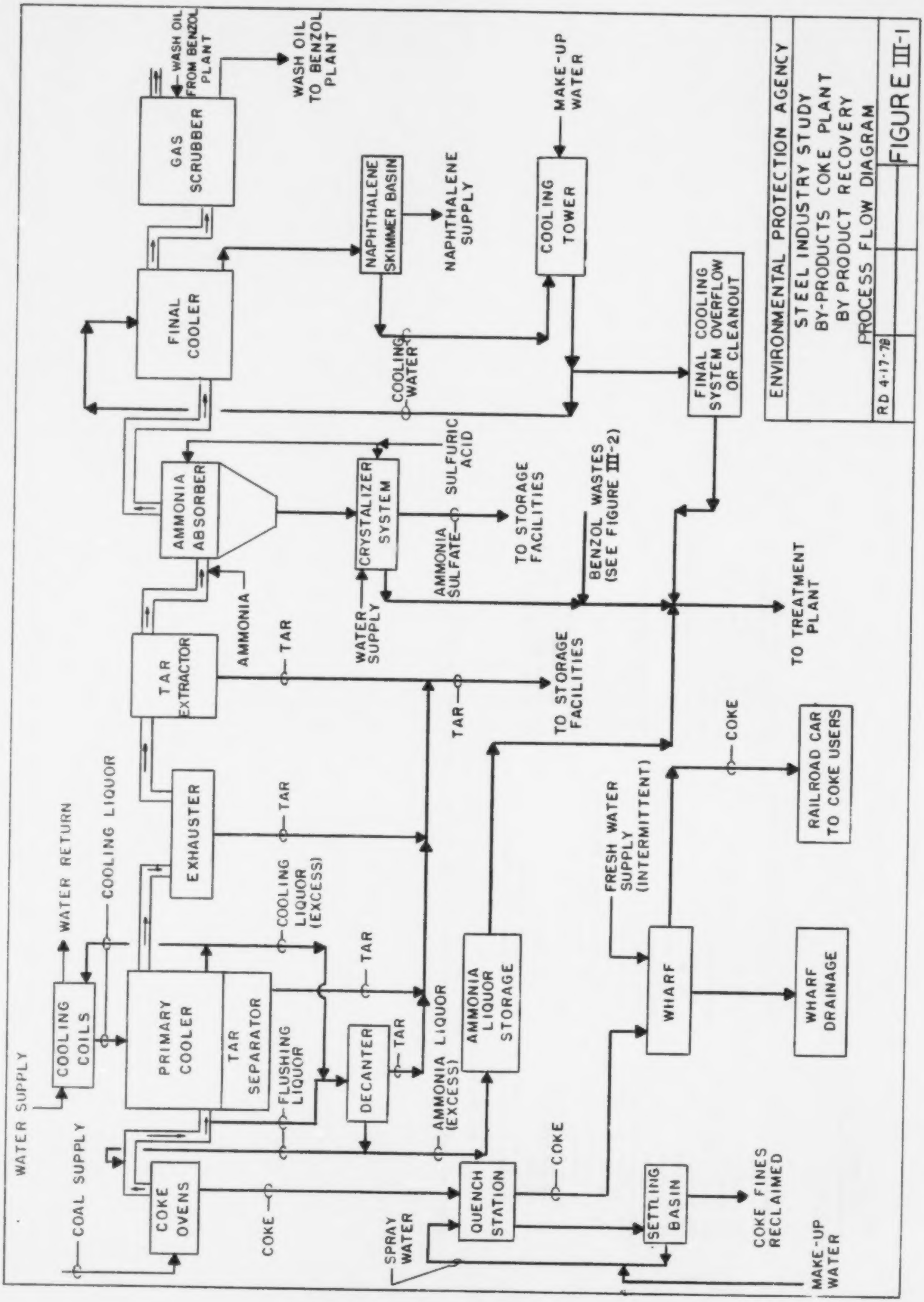
-1- Plant 1
-2- Plant 2
-3- Plant 3
-4- Plant 4
(B) Brown's Island
(M) Mainland
(R) Rosedale
(F) Franklin
TPD: Tons per day
GPD: Gallons per day
GPT: Gallons per ton
NH_3: Ammonia Recovery Type
  1: Semidirect
  2: Indirect
  N: No NH_3 Recovery
DS: Desulfurizer Type:
  D: Dry
  N: No Desulfurizer
  Number: Gallons of Wastewater Per Ton of Coke

ASL or ASC: Fixed Ammonia Still
  I: Inactive
  N: None
N: No Ammonium Product
ØOH: Phenol Recovery:
  Y: Yes
  N: No
I: Inactive
BTX Recovery:
  C: Crude
  R: Refined
  N: None
  OTH: Other Product Recovered (See Footnotes)
ASF: Free Ammonia Still
  Y: Yes
  I: Inactive
CH: Chemical Oxidation
Bio: Biological Treatment

CA: Carbon Adsorption
In: Initial Installation of Treatment Plant
Ret: Retrofit Installation of Treatment Plants
Unk: Unknown
*: Plant requested confidential treatment of data.

(1) Process Wastewaters Only
(2) Naphthalene
(3) Ozone
(4) Incineration
(5) Sulfur
(6) Oxidation Tower
(7) Impoundment Lagoon
(8) Ceased Operation in 1979
(9) Anhydrous Ammonia

NOTE: For definitions of other operational and control and treatment codes, refer to Table VII-1.

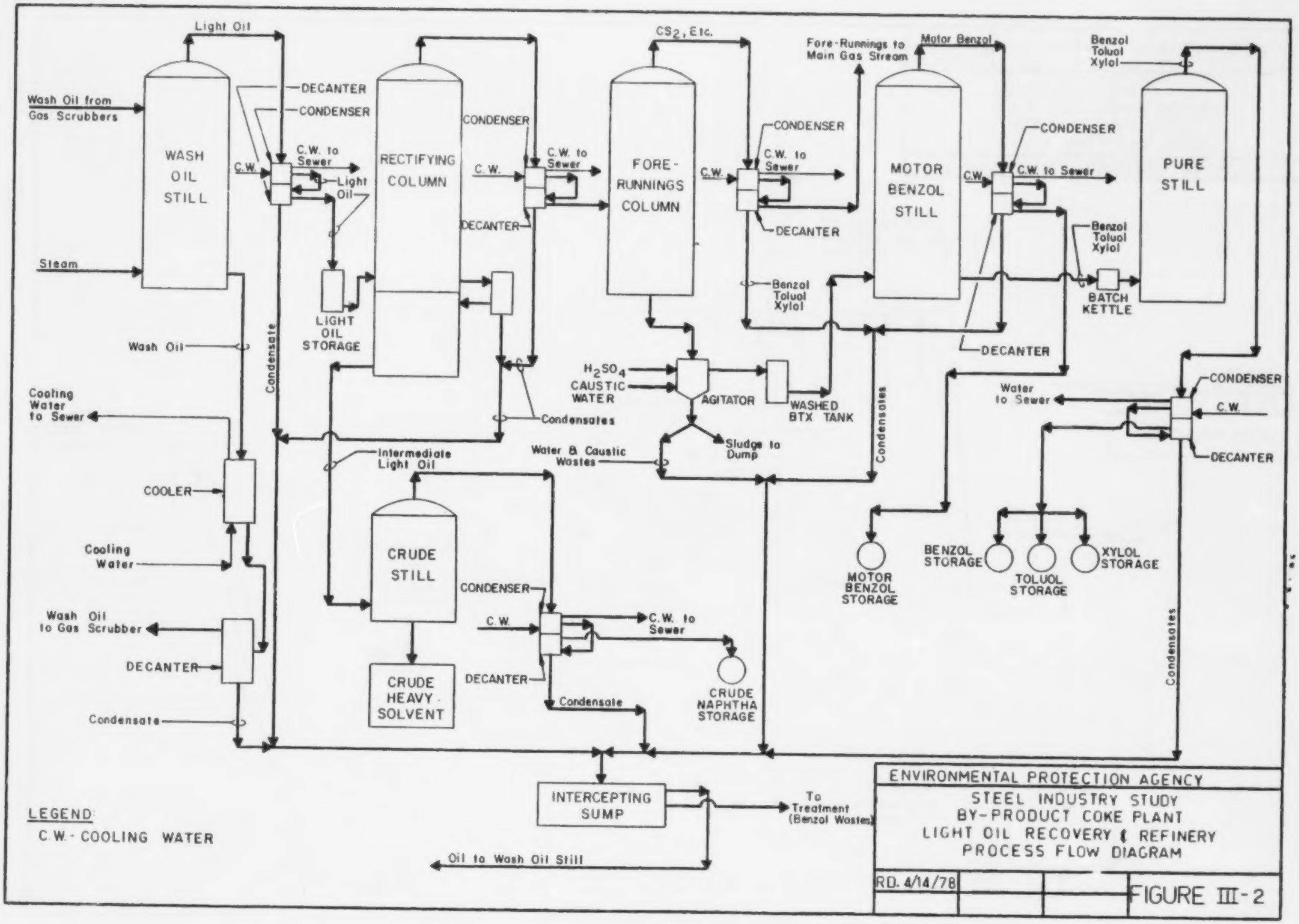

COAL SUPPLY
WATER SUPPLY
COKE OVENS
COKE
COOLING COILS
WATER RETURN
COOLING LIQUOR
PRIMARY COOLER
TAR SEPARATOR
FLUSHING LIQUOR
DECANTER
TAR
COOLING LIQUOR (EXCESS)
AMMONIA LIQUOR (EXCESS)
AMMONIA LIQUOR
EXHAUSTER
TAR
TAR EXTRACTOR
TAR
TO STORAGE FACILITIES
AMMONIA
AMMONIA ABSORBER
CRYSTALIZER SYSTEM
SULFURIC ACID
AMMONIA SULFATE
TO STORAGE FACILITIES
WATER SUPPLY
BENZOL WASTES (SEE FIGURE III-2)
TO TREATMENT PLANT
FINAL COOLER
COOLING WATER
NAPHTHALENE SKIMMER BASIN
NAPHTHALENE SUPPLY
GAS SCRUBBER
WASH OIL FROM BENZOL PLANT
WASH OIL TO BENZOL PLANT
COOLING TOWER
MAKE-UP WATER
FINAL COOLING SYSTEM OVERFLOW OR CLEANOUT
SPRAY WATER
QUENCH STATION
COKE
AMMONIA LIQUOR STORAGE
SETTLING BASIN
COKE FINES RECLAIMED
MAKE-UP WATER
FRESH WATER SUPPLY (INTERMITTENT)
WHARF
WHARF DRAINAGE
COKE
RAILROAD CAR TO COKE USERS

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCTS COKE PLANT
BY PRODUCT RECOVERY
PROCESS FLOW DIAGRAM

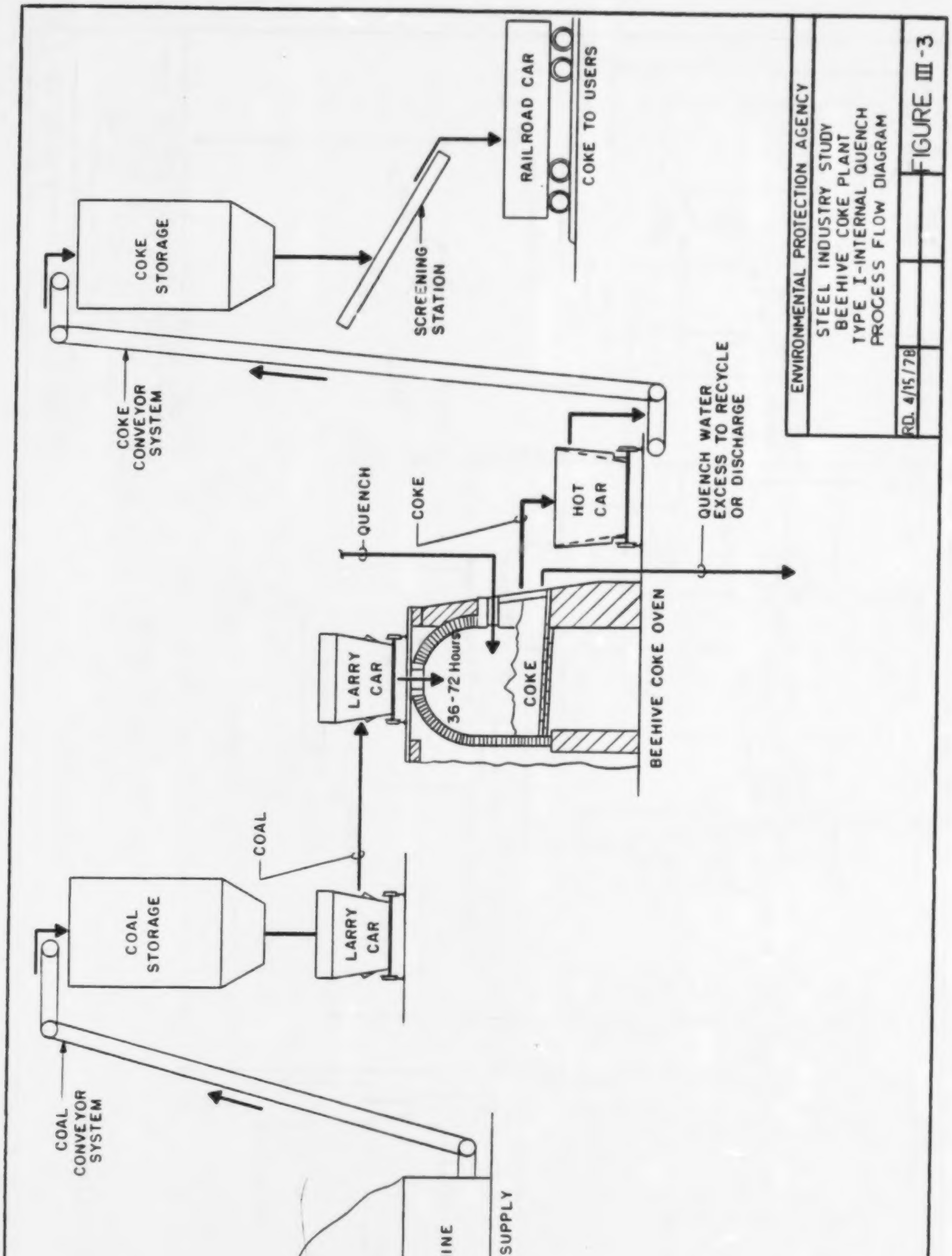
RD 4-17-78

FIGURE III-1


Light Oil
Wash Oil from Gas Scrubbers
WASH OIL STILL
Steam
DECANTER
CONDENSER
C.W.
C.W. to Sewer
Light Oil
LIGHT OIL STORAGE
RECTIFYING COLUMN
CONDENSER
C.W.
C.W. to Sewer
DECANTER
Condensate
Wash Oil
Condensates
Intermediate Light Oil
Cooling Water to Sewer
COOLER
Cooling Water
Wash Oil to Gas Scrubber
DECANTER
Condensate
CRUDE STILL
CRUDE HEAVY SOLVENT
CONDENSER
C.W.
C.W. to Sewer
DECANTER
Condensate
CRUDE NAPHTHA STORAGE
CS$_2$, Etc.
FORE-RUNNINGS COLUMN
CONDENSER
C.W.
C.W. to Sewer
DECANTER
Fore-Runnings to Main Gas Stream
Benzol Toluol Xylol
H_2SO_4
CAUSTIC WATER
AGITATOR
WASHED BTX TANK
Sludge to Dump
Water & Caustic Wastes
Condensates
Motor Benzol
MOTOR BENZOL STILL
CONDENSER
C.W.
C.W. to Sewer
DECANTER
Benzol Toluol Xylol
BATCH KETTLE
PURE STILL
CONDENSER
C.W.
DECANTER
Water to Sewer
MOTOR BENZOL STORAGE
BENZOL STORAGE
TOLUOL STORAGE
XYLOL STORAGE
Condensates
INTERCEPTING SUMP
To Treatment (Benzol Wastes)
Oil to Wash Oil Still

LEGEND:
C.W. - COOLING WATER

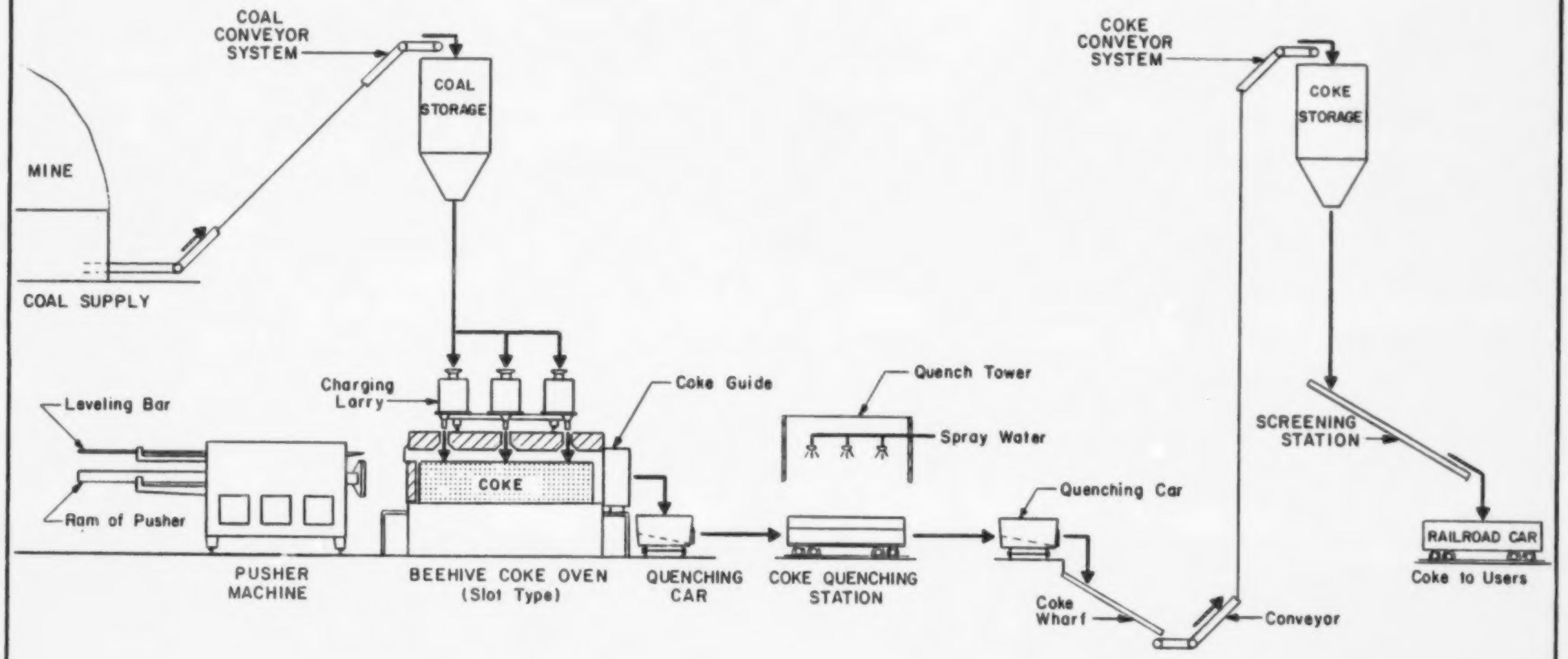
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
LIGHT OIL RECOVERY & REFINERY
PROCESS FLOW DIAGRAM
RD. 4/14/78
FIGURE III-2


MINE
COAL SUPPLY
COAL CONVEYOR SYSTEM
COAL STORAGE
LARRY CAR
COAL
LARRY CAR
36-72 Hours
COKE
BEEHIVE COKE OVEN
QUENCH
COKE
HOT CAR
QUENCH WATER EXCESS TO RECYCLE OR DISCHARGE
COKE CONVEYOR SYSTEM
COKE STORAGE
SCREENING STATION
RAILROAD CAR
COKE TO USERS
RD. 4/15/78

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEEHIVE COKE PLANT
TYPE I-INTERNAL QUENCH
PROCESS FLOW DIAGRAM

FIGURE III-3


COAL CONVEYOR SYSTEM
COAL STORAGE
MINE
COAL SUPPLY
Charging Larry
Coke Guide
Leveling Bar
Ram of Pusher
COKE
PUSHER MACHINE
BEEHIVE COKE OVEN (Slot Type)
QUENCHING CAR
Quench Tower
Spray Water
COKE QUENCHING STATION
Quenching Car
Coke Wharf
Conveyor
COKE CONVEYOR SYSTEM
COKE STORAGE
SCREENING STATION
RAILROAD CAR
Coke to Users

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEEHIVE COKE PLANT
TYPE II-EXTERNAL QUENCH
PROCESS FLOW DIAGRAM

RD. 4/15/78

FIGURE III-4

COKEMAKING SUBCATEGORY

SECTION IV

SUBCATEGORIZATION

Introduction

The Agency decided to subdivide the cokemaking subcategory into by-products recovery and beehive processes because of the basic differences in process equipment and final products.

The Agency concluded that further subdivisions within each of these processes, were not appropriate, despite certain differences in configuration and product line. The Agency believes that these differences are best addressed by establishing basic conditions applicable to all coke plants, and then providing for specific incremental effluent limitations for qualifying plants based upon variations from the basic conditions. Accordingly, the proposed regulation contains allowances for desulfurization using wet absorption methods, and the practice of indirect ammonia recovery as the hydroxide.

Factors evaluated with respect to subcategorization and subdivision are discussed below in greater detail.

Factors Considered in Subcategorization

Manufacturing Process and Equipment

Major differences between the production equipment used and the nature of the cokemaking process form the basis for subdividing cokemaking into by-products and beehive operations. In the by-products recovery ovens, the exclusion of air and the use of flushing liquor to condition coke oven gas generates significant quantities of various types of wastewaters. The most highly contaminated of these wastewaters originates from the moisture of the coal itself, and takes the form of excess flushing liquor which must be continuously removed from the flushing liquor system. This same moisture is vaporized in the beehive process, along with other volatile constituents of the coal. Air is admitted into the ovens to burn these volatiles to provide additional heat for the coking process.

Since there are basic differences in manufacturing process, it follows logically that the process equipment likewise differs between beehive and by-products recovery operations. The beehive operations are much simpler than the by-product operations. Both processes have coke quenching in common, but the by-product recovery process also may include operations such as ammonia recovery, dephenolization, desulfurization, light oil refining and scrubbing of emissions from coal and coke handling, coal charging, and coke pushing. These additional processing operations and variations in equipment cause enough differences in wastewater quantity, quality and treatability to warrant separate limitations for by-product and beehive cokemaking processes even though both start with the same raw material; coal. Within the by-product cokemaking operations, variations in manufacturing process and equipment relate directly to the by-products recovered. However, wastewaters from all operations at a given site are usually combined and treated in a single treatment system. Where appropriate, incremental effluent limitations for by-product recovery are provided over and above the basic effluent limitations for all plants.

Final Products

Although both processes have the production of coke as their primary objective, the by-products recovery cokemaking operations yield a wide variety of final products, including coke oven gas, and crude coal tars (see Section III, Table III-3). But even these basic products differ from plant to plant. The coke itself can be either furnace coke for use in blast furnace iron-making, or foundry coke for cupola use. Coke oven gas can vary depending on the chemical composition of the coals coked and the degree of cleaning and conditioning provided for the gas prior to its ultimate use. These factors will also influence the quality of the coal tars recovered. Other recovered by-products will determine the volume and quality of certain wastewater streams. For example, most by-products plants use semi-direct ammonia recovery methods producing ammonium sulfate or ammonium phosphate. However, six by-product plants use indirect methods which produce ammonium hydroxide instead. This latter process yields larger volumes of wastewater than do semi-direct recovery methods. There are other differences in wastewater generation rate and quality resulting from recovery of crude or refined light oils, from sulfur recovery, from dephenolization, and from final cooler operations, whether recycled or once-through. Impacts from these variations are discussed in more detail in Sections IX and X. No such variations exist for beehive operations, which generate less noxious wastewaters. As a result, the Agency believes that the basic subdivision of cokemaking into beehive and by-products recovery processes is appropriate in part because of the diverse final products produced by the latter operations.

Raw Materials

While raw materials are a principal factor in subcategorizing the steel industry, the coals used in the cokemaking subcategory have little influence on segmenting the cokemaking subcategory. Although variations in coal chemistry do affect wastewater quality and quantity, other factors such as the presence or absence of by-products recovery components and air pollution emission controls are of much greater significance. Within the by-product cokemaking segment, coals are blended to provide the most desired combination of characteristics in the end product. Thus, the eventual generation of wastewaters requiring control and treatment is influenced by other factors to a much greater extent than by variations in raw material charged to the ovens, and these influences are adequately covered by incremental effluent limitations where appropriate.

Wastewater Characteristics

As indicated above in the discussion of manufacturing processes, beehive and by-product cokemaking generate significantly different wastewaters. Process wastewaters from beehive operations are related strictly to quenching operations, and as such are readily controlled by sedimentation for suspended solids. The excess quench water is collected and evaporated on the hot coke product. The volume of wastewaters generated by the beehive process vary only slightly from plant to plant.

The by-product recovery processes, on the other hand, generate excess flushing liquors, benzol plant wastes, final cooler wastewaters, desulfurizer wastes, air pollution control scrubber waters and tar decanter wastewaters in addition to the wastewaters from quenching operations. In contrast to beehive operations, these wastewaters contain pollutants other than suspended solids such as ammonia-N, cyanides, phenolic compounds, sulfides, oil and greases, acids and alkalis, as well as many toxic organic pollutants. For more details on cokemaking wastewater characteristics refer to Section V.

Wastewater Treatability

Wastewaters from beehive cokemaking operations are effectively treated by simple sedimentation in settling ponds to drop out any coke fines picked up during quenching. Pond overflows are readily recycled to the quenching operation, with minimal impact on air quality due to the general absence of pollutants other than TSS. Within by-products recovery plants, treatment systems have been developed to control certain combinations of pollutants, while often others are left uncontrolled, or eliminated by means other than treatment. For example, 33 by-products plants dispose of their most aggressive wastewaters by evaporation in quenching operations, as in the beehive operations. But because by-products wastewaters contain high dissolved solids and many volatile pollutants, this practice has a significant adverse impact on air quality. Two plants practice deep well injection. A few coke plants have extensive treatment systems which incorporate sophisticated technologies to control the pollutant load from the entire waste flow. However, even among these plants, two distinctly separate approaches to treatment are currently practiced.

A number of by-products coke plants operate biological oxidation systems with one or more stages for controlling process wastewaters. This control and treatment technology has proven to be at least as effective as physical/chemical methods (activated carbon) at treating the toxic organic pollutants found in cokemaking wastewaters, but at less cost. Others operate physical/chemical treatment systems to selectively eliminate certain pollutants. The best of these systems use activated carbon adsorption to remove phenolic compounds, but the operating costs for advanced treatment (beyond BPT) are several times higher than that for advanced biological treatment. Wherever possible, plants which have yet to choose a treatment alternative should consider the advantages of biological systems. Analytical and cost data for both systems are included in later discussions. The biological systems form the basis for effluent limitations covering most operating by-product cokemaking operations. Separate BAT effluent limitations are proposed for those plants which have installed advanced physical/ chemical treatment systems. The Agency is proposing BAT, BCT, NSPS, PSPES and PSNS limitations and standards for all other cokemaking plants based upon biological treatment models.

Size and Age

Consideration was given to the impact of size and age when subdividing the cokemaking subcategory into beehive and by-product operations. Beehive plants tend to be only about one-fourth as large as by-products plants. And even though the beehive process is an older technology, the only beehive plant known to be active is "newer" than many by-product plants. Thus, these size and age differences are covered by the basic subdivision into two manufacturing processes. Within the individual cokemaking processes size and age are less relevant.

With respect to size expressed as rated capacity, the ratio between the largest and smallest by-product cokemaking facility for which flow data are available is 39:1, yet the corresponding ratio between total daily raw waste flows for those two plants is less than 6:1. The Agency could not discern a significant pattern involving flow rates per unit of production. The total raw wastewater generation rates expressed as gallons per ton of coke produced average 154 GPT for the five largest by-product plants, and 143 GPT for the five smallest. The range of flows for large plants is narrower than for small, primarily because the larger ones practice similar degrees of by-product recovery while by-product recovery at the smaller plants is highly variable. As noted above, these differences are covered by incremental effluent limitations within the by-product segment rather than further segmentation on the basis of size.

One area seemingly influenced by size of by-product coke plants is the choice of wastewater disposal means. Pretreated wastewaters from two of the ten largest coke plants are discharged to publicly owned treatment works (POTWs), while wastewaters from six of the ten smallest plants are discharged to POTWs. It is often not feasible for larger coke plants to discharge to POTWs because of the adverse impacts these wastewaters can have on POTW operations and performance. Oftentimes, coke plant wastewaters are not effectively treated in POTWs. Hence, the Agency discourages this practice.

The Agency has concluded that subcategorization based upon size is not appropriate. A scatter diagram of by-products cokemaking plants plotting rated capacity versus flow, and identifying those which discharge either directly or indirectly is given as Figure IV-1. Note that most plants, large and small, are generating wastewater at less than 250 gal/ton, indicating that size has little impact on flow.

The Agency did not find any impact relating to the age of a coke plant other than the indirect one derived from the subdivision into by-products recovery and beehive segments. To begin with, age itself is a relative term, since most coke plants have been in operation much longer than their current "oldest" active production units. Data from all by-products recovery plants were used to plot a scatter diagram, Figure IV-2, showing the year of rebuild for the oldest active battery on-site versus flow for each plant. Many sites show oldest active batteries built between 1940 and 1962. Flows appear to be independent of year of rebuild, since high and low flows occur in any age group, indicating that age has no impact on flow. Further support can be shown by comparing wastewater generation rates for old and new plants. Defining age by "oldest active battery", the five oldest plants average 191 GPT, while the five newest average 205 GPT, a difference of only 7%. If age is defined as "first date of cokemaking on-site", these flows are 175 GPT for old plants and 185 GPT for new plants. The Agency believes that these differences are not significant.

Plants vary from 6 to 78 years old if first year of operation is the criterion for age, or from 5 to 63 years old if oldest active battery is considered. The oldest site, 78 years, is only 11 years old if oldest active battery is selected as the criterion for "age". From the available data for age it can be shown that the "average" by-product cokemaking plant has had cokemaking on-site for at least 50 years, although the oldest active batteries are 31 years old and the newest only a few years old. Wastewater treatment systems (other than those which are purely by-product recovery system components) date back 10 to 12 years, and have usually been upgraded within the last 5 to 6 years.

The Agency also found that age does not have a significant impact on wastewater characteristics or treatability. Among the surveyed plants, the newest and best treatment facilities were found at three locations which have been making coke for more than 70 years, with active batteries at least 25 years old. Also, to further complicate the concept of plant age, there can be a significant distinction between active campaign years and calendar years. The former involves actual use of a battery of ovens, which may be only 20 years during a 35 calender year period. The need to rebuild major portions of an operating coke plant at various intervals provides an opportunity to install or upgrade wastewater treatment components with minimal disruption to the remaining process operations. A review of DCP responses indicated that 68% of the plants provided some upgrading of wastewater treatment equipment to coincide with the rebuild of active batteries.

In response to the Court's remand, the Agency compared industry's actual cost for pollution control facilities with its estimated model plant costs. The objective of the comparison was to determine the relative ease with which the model wastewater technology equipment can be retrofitted to existing systems and production units. Based on that comparison, the Agency concludes that its model cost estimate is sufficiently generous to cover the associated retrofit costs for plants of all "ages." As additional support, a review of the list of plant ages versus installation dates for treatment systems confirms that most plants can and do retrofit treatment systems to existing production facilities (Refer to Table IV-1 for data).

Geographic Location

The Agency has concluded that location does not have a significant effect upon subcategorization or further subdivision, other than the fact that beehive ovens tend to be located in rural areas within bituminous coalfields (Pennsylvania, West Virginia, Virginia and Kentucky), while by-products recovery plants are situated at locations where their by-product gas can be used as fuel (i.e., at integrated steel works, or urban areas where gas can be distributed to other users). The Agency accounts for this distinction by subdividing the cokemaking subcategory into by-products and beehive processes.

By-product cokemaking needs no further segmentation because of location. By-product recovery plants are situated in 17 states, but half of the total number operate in Pennsylvania, Ohio, and Alabama. Only six are found west of the Mississippi River (2 in Texas, 1 each in California, Colorado, Missouri, and Utah). The Agency did not find any significant differences due to geographic location. The effect of location in terms of arid or semi-arid regions is discussed in Section VIII.

Process Water Usage Rates

For beehive operations, flows are a function of the quenching rate, and are uniform from plant to plant. Excess quench water is collected and recycled to the operation, thus minimizing the need for makeup water. The Agency did not observe any variations in process water usage, and, accordingly, believes a single model flow suffices for beehive operations. The raw wastewater flows reported to EPA for by-product cokemaking installations varied widely from plant to plant, with a low of 33 gallons per ton of coke produced to a high of 1395 gallons per ton. These flows include process wastewaters only as non-contact cooling waters have been excluded from total flows where possible. Such wide variation in flow reflects the diverse nature of water usage and conservation practices at cokemaking operations. Plants which have low flows also practiced minimum recovery of by-products, and rarely had any auxiliary equipment such as charging or pushing emission control scrubbers or desulfurizers.

Although such differences are important to note when regulating discharges from individual plants, the Agency believes that these variations can be accounted for by providing incremental effluent limitations where appropriate rather than by further subdivision. These limitations are allowed for plants practicing indirect ammonia recovery and wet gas desulfurization and are in addition to the base limitations applicable to all plants. Additional discussion of these water usage and wastewater generation flow rates is provided in subsequent sections, particularly in Section V.

Consideration of Process Changes

The BAT model treatment system does not include any in-process changes although wastewater quality may change when discharge rates are reduced. Many plants are employing recycle, reuse or treatment and recycle to minimize water use and the volume of effluents discharged.

The proposed limitations are mass limitations (unit weight of pollutant discharged per unit weight of product) and not volume or concentration limitations. While the proposed limitations can be achieved by extensive treatment of the large flows, the Agency believes that the proposed limitations can, in more instances, be achieved more economically by minimizing effluent volumes.

TABLE IV-1

EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED AN ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT TO EXISTING PRODUCTION FACILITIES

		Cokemaking Subcategory Age of Production Facilities				Age of Treatment System		
			Active Batteries					
Cokemaking Process	Plant Reference Number	First Year On-Site (Year)	Oldest (Year)		Newest (Year)	Installed (Year)		Upgraded (Year)
Beehive	E	~1930	1963		1970	-	1970	-
	F	~1930	1970		1970	1970		1973
	G	~1920	-	1960	-	1960		1968
By-Product Recovery	0012A	1920	1941		1968	-	1977	-
	0012B	1919	1966		1967	1974		1979
	0024A	1953	1953		1967	1972		1978
	0024B	1901	-	1968	-	1969		1977
	0060	1953	1953		1977	1953		1977
	0060A	1928	1959		1969	1947		1978
	0112	1914	1941		1976	1962		1979
	0112A	~1920	1941		1961	1976		1978
	0112C	1921	1948		1965	-	1978	-
	0248A	1912	1948		1951	-	1971	-
	0272	1919	1942		1968	1957		1977
	0280B	1929	1929		1963	-	1977	-
	0396A	1906	-	1955	-	-	1972	-
	0402	1917	1917		1955	1917		1971
	0448A	1942	1943		1959	-	1973	-
	0464C	1925	1942		1952	-	1971	-
	0464E	1914	1925		1970	1914		1978
	0584F-M	1923	1947		1956	-	1976	-
	0684D	1927	-	1955	-	-	1975	-
	0684F	1917	1943		1977	1960		1976
	0684I	1918	1942		1965	1970		1974
	0684J	1914	-	1952	-	-	1976	-
	0732A	1929	1950		1958	1952		1979
	0810	1917	-	1962	-	-	1975	-
	0856A	1918	1948		1977	-	1975	-
	0856N	1917	1947		1957	1917		1971
	0920B	1942	1942		1956	1942		1977
	0920F	1917	1940		1976	-	1978	-

TABLE IV-2

ANNUAL TONS OF POLLUTANTS REMOVED BY TREATMENT

Pollutant	Present In Feed	Removed By BPT Treatment		Removed by BAT Alt. 1		Discharged	
	T/Yr	Tons/Yr	% of Feed	Tons/Yr	% of Feed	Tons/Yr	% of Feed
			Conventional Pollutants				
TSS	2,810	(3,110)	(110.7)	4,880	173.7	1,040	37.0
Oil & Grease	4,210	3,090	73.4	850	20.2	270	6.4
SUBTOTAL-CP	7,020	(20)	(0.3)	5,730	81.6	1,310	18.7
			Toxic Pollutants				
Cyanides	2,810	570	20.3	2,070	73.7	170	6.0
Metallics	152	93	61.2	35	23.0	24	15.8
Phenolics	16,840	16,800	99.8	36	0.2	4	0.02
Organics Other than Phenolics	6,650	6,340	95.3	273	4.1	37	0.6
SUBTOTAL-Toxics	26,452	23,803	90.0	2,414	9.1	235	0.9
			Pollutants Other Than Conventionals or Toxics				
Ammonia	33,690	26,170	77.7	6,660	19.8	860	2.5
Sulfide	8,420	8,270	98.2	59	0.7	91	1.1
Thiocyanates	26,950	25,940	96.2	365	1.4	645	2.4
SUBTOTAL-Other	69,060	60,380	87.4	7,084	10.3	1,596	2.3
TOTAL	102,532	84,163	82.1	15,228	14.8	3,140	3.1

( ): Numbers in parenthesis represent loads which have been added during treatment.

NOTE: Table assumes that 57 plants treat wastewaters via biological oxidation systems, and 2 plants use physical/chemical means, including carbon adsorption. Feed is wastewater which has passed through free ammonia stripping stills, but has not been dephenolized.

FIGURE IV-1

BY-PRODUCT COKE MAKING FLOW vs. SIZE

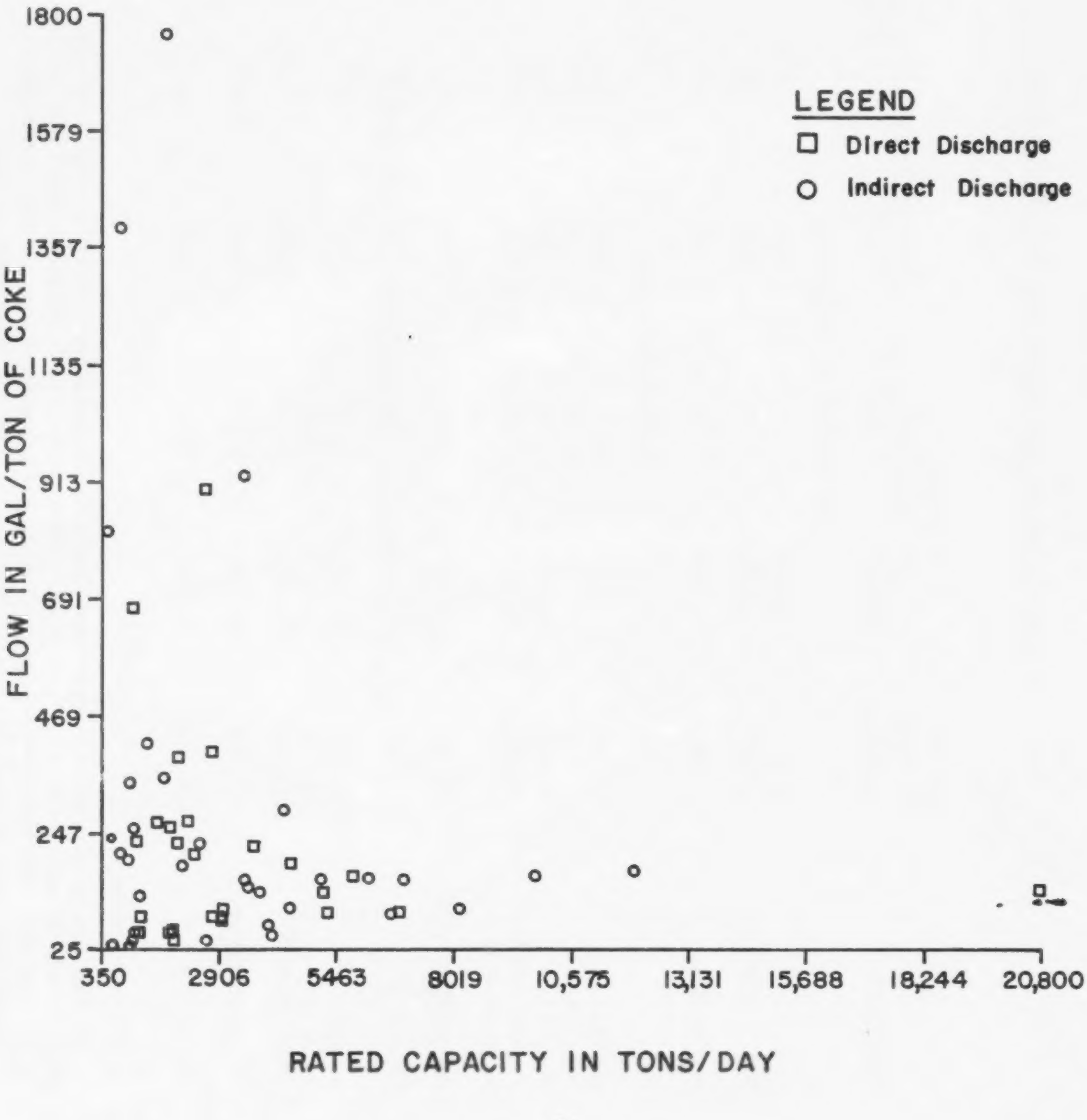
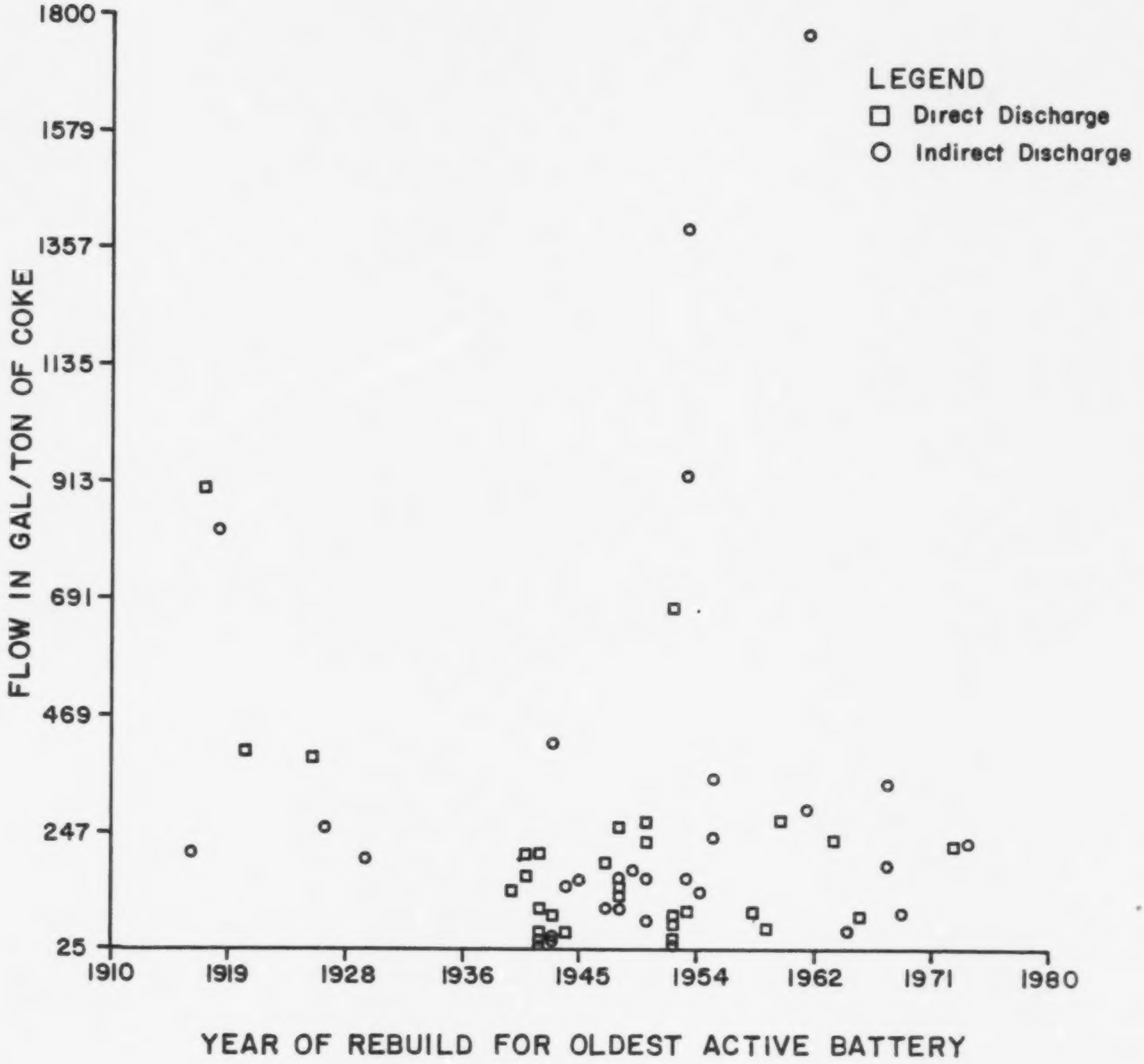


FIGURE IV-2

BY-PRODUCT COKE MAKING
FLOW vs. AGE



COKEMAKING SUBCATEGORY

SECTION V

WATER USE AND WASTE CHARACTERIZATION

Introduction

The sources and characteristics of process wastewaters generated during cokemaking operations are reviewed herein, with particular emphasis on by-product cokemaking wastewaters. Water use rates were measured during field sampling of selected plants, and also were obtained for all known active by-product plants through DCPs. For the two beehive operations, field data alone were used. Since the only process wastewater source for beehives is quenching runoff, and this source is readily recycled, the Agency did not solicit additional data with DCPs.

Waste characterization for both cokemaking processes is based upon analytical data obtained during the field sampling programs. Long-term data were obtained from selected companies by detailed data collection portfolios (D-DCPs), which were also used to supplement available cost information. Additional data were acquired by EPA regional staff with the cooperation of individual companies, and from the activities of EPA's Office of Research and Development.

Water use rates discussed below pertain only to process wastewaters, and not to non-contact or non-process cooling water.

Sources

General process and water flow diagrams of a conventional by- product coke plant and associated light oil recovery plant are presented as Figures III-1 and III-2. Typical beehive operations are shown on Figures III-3 and III-4. In actual practice, 75% of the by-product coke plants attempt some degree of ammonia recovery as shown on Figure III-1, and even more recover crude light oils. However, only about 25% refine light oils to the extent shown on Figure III-2.

The typical products generated during the carbonization of a metric ton (1.1 short tons) of coal in the by-product cokemaking process are as follows:

Coke Oven Gas	350 cu. m	(12,500 cu. ft.)
Tar	35 liters	(9.2 gal)
Ammonia as Nitrogen	2.4 Kg	(5.3 lb)
Tar Acids	2.4 Kg	(5.3 lb)
Hydrogen Sulfide	3.0 Kg	(6.6 lb)
Light Oils	12 liters	(3.2 gal)
Coke - Sized	625 Kg	(1380 lb)
Coke - Undersized	75 Kg	(160 lb)
Water	132 liters	(35 gal)

Although the above list summarizes the "typical" quantities recoverable from grades of coal commonly used for cokemaking, the Agency observed wide variations for individual coals which are due to differences in coal chemistry, moisture and volatility. For example, the quantities of coke oven gas generated per metric ton of coal coked which were reported by 58 coke plants varied from 216 to 523 cubic meters per metric ton (7,000 to 16,970 cubic feet per short ton).

Raw waste loads from by-product cokemaking operations vary widely, not only as a result of differences in coals used, but also due to variations in recovery processes, water use systems, operating temperatures of the ovens, and the duration of the coking cycle. However, all such variations are subject to effective control by the treatment systems considered herein. Raw wastewater flows generated by the nine by-product coke plants sampled during this study were found to range from 90 to 580 l/kkg (21.6 to 139 gallons per ton) of coke produced. Maximum and minimum effluent flows vary even more widely since several options exist for treating each coke plant wastewater. For example, most plants which use biological treatment add some dilution water to optimize conditions for the bioxidizing organisms. Also, some plants dispose of some raw or treated wastewaters by quenching. Effluent flows from these plants are lower than from plants where all wastewaters are discharged.

The most significant liquid wastes generated during by-product cokemaking and by-product recovery operations include excess ammonia liquor, final cooler wastewater, light oil recovery wastes from the benzol plant, barometric condenser wastes from the crystallizer, desulfurizer wastes, and contaminated waters from air pollution emission scrubbers for charging, pushing, preheating or screening operations. In addition, miscellaneous wastewaters may result from coke wharf drainage, quench sump overflows, and coal or coke pile runoffs. Runoffs from storage piles and coke wharves should be contained within a diked area and impounded until evaporated, or collected and transferred to the plant's wastewater treatment system. Condensates from drip legs and gas lines, along with leakage from sample test taps and floor washdowns should also be routed to treatment prior to release, since significant loads can originate from these diverse sources. Among the possible means for control, the following methods are most applicable:

1. Collection and channeling of miscellaneous sources to process wastewater treatment systems.

2. Impoundment with no discharge, provided that subsurface discharge through percolation is prevented by the use of impervious materials to line lagoons, storage ponds, and runoff collection stations.

3. For situations where the impact on air pollution can be tolerated, a system of recycle to extinction by coke or slag quenching operations may be acceptable.

The largest volumes of water leaving a by-product coke plant are indirect (noncontact) cooling waters from a variety of cooling and condensing operations. These flows are not normally considered process wastewaters, but leaks in coils or tubes can result in significant incursion of aggressive wastes into these flows. However, frequent inspection and proper maintenance will prevent such contamination from process waters, so flows of this type are not included in the discussion of process wastewaters and pollutant loads.

The volume of excess ammonia liquor produced from the distillation of coal varies from 79 to 430 l/kkg (19 to 103 gal/ton) of coke at plants using semi-direct ammonia recovery, and from 292 to 442 l/kkg (70 to 106 gal/ton) at plants using indirect recovery. Ammonia liquor was sampled separately at six coke plants and as part of a mixed flow at two coke plants. Measurements showed excess ammonia liquor flows of 90 to 205 l/kkg (21.6 to 49.3 gal/ton). The concentration and loads for pollutants of interest are shown in Table V-1 for the original guidelines survey, and in Table V-2 for the toxic pollutant survey. Net concentrations are used because such values provide a measure of the pollutant loads attributable to the process. Net concentrations were calculated by subtracting all "background" pollutant concentrations. Note the major pollutants found in excess ammonia liquor are directly related to the destructive distillation of coal. Since excess flushing liquors represent the first step in cooling the coke oven gas for reuse, the waste ammonia liquor contains by far the greatest pollutant load. All by-products recovery plants generate excess ammonia liquor.

Final cooler wastewater originates from direct contact cooling of coke oven gas with water sprays which dissolve any remaining soluble gas components and physically flush out condensed naphthalene crystals. Final cooler wastewater volume ranges from 46 to 709 l/kkg (11 to 170 gal/ton), but this volume can be reduced to between 8.3 and 42 l/kkg (2 to 10 gal/ton) by recycle. Nearly 85% of the by-products coke plants have some wastewater from this source.

Currently available, separate, and complete analytical data (including toxic pollutants) for final cooler blowdowns are from a single plant whose blowdown flow was an atypical 294 l/kkg (70.5 gallons per ton) of coke produced. These data are shown in Table V-3 for 31 pollutants. Although waste ammonia liquor is the most contaminated wastewater, the levels of certain volatile pollutants (e.g., benzene, cyanide, isophorone, and toluene) in final cooler wastewaters exceed those in ammonia liquor. Additional data for mixtures of final cooler wastewater and benzol plant wastwaters are shown in Table V-4.

Light oil recovery (benzol plant) waste volumes also vary widely, depending upon the degree of recovery (crude or refined), and whether recirculation is practiced. Although once-through systems generate from 835 to 6,260 l/kkg (200 - 1,500 gal/ton), recirculation is usually practiced which reduces the discharge flows to between 63 and 500 l/kkg (15 to 120 gal/ton). Toxic pollutant concentrations found in benzol plant (light oil recovery) wastewaters are shown in Table V-5. Certain toxic organics (e.g., benzo(a)pyrene, isophorone, parachlorometacresol) common in other coke plant wastewaters were not detected in benzol plant wastewaters. Also, most of the pollutant concentrations observed in benzol plant wastewaters are significantly lower than those in the other coke plant wastewaters. Notable exceptions are benzene, toluene and xylene, which were found in benzol plants wastes at 3 to 7 times higher concentrations than in other wastes. As in the case of final cooler wastewaters, nearly 85% of the by-products recovery plants have some flow from benzol plant processes.

As noted above, three sources of wastewater are common to most by-product cokemaking operations. Additional sources include steam condensates from ammonia and phenol recovery units, drip legs, test taps, floor drains and washdowns and runoffs from coke quenching operations. Steam condensates have been measured at 10 to 20% of the wastewater volumes delivered to the recovery units. The other combined "miscellaneous wastewaters" were found at flows from 30 to 350 l/kkg (7 to 84 gallons/ton), depending to a large extent upon the degree of housekeeping and maintenance provided. Some plants have been able to apply practices which minimize flows requiring treatment prior to disposal, while others have chosen not to, and allow such sources to be consumed in quenching operations.

Coke quenching operations for by-products recovery and beehive operations require an applied rate of 500 to 3,750 l/kkg (120 to 900 gal/ton), with an average application rate of 2,100 l/kkg (500 gal/ton). Approximately one-third of this applied flow (130 gal/ton) is evaporated during each quench. The runoffs are collected in a sump and reused for subsequent quenches with no discharge of wastewater to treatment or receiving streams. Thirty-one by-product coke plants dispose of much of their process wastewaters by quenching. The process wastewaters which are most often disposed of in this fashion are final cooler blowdowns and benzol plant wastes. In nearly all cases, fresh water is mixed with the wastes, but in at least one plant, the quench stations operate using more than 90% contaminated water.

The water application rates required for quenching result from attempts to strike a balance between the need to quench the incandescent coke, and yet leave enough heat behind to evaporate water trapped within the coke lumps. If this entrapped water is primarily contaminated waste, many of the contaminants are transferred to the blast furnace, thereby increasing the pollutant waste loads at the blast furnace gas washers. To further compound the problem of using contaminated wastewater for quenching, studies have indicated increased metal corrosion in and around quench stations which use "dirty water" quenching as opposed to stations using fresh water makeup only. Also, particulate emissions from a quench tower which used contaminated and then fresh makeup water in different test runs were found to be more than twice as high with dirty water for quenching, (i.e., 45 pounds of particulate/quench with dirty versus 21 pounds/quench with clean). The difference was related to the higher level of dissolved solids in the contaminated makeup water. Thus, even the use of sophisticated wastewater treatment techniques such as pretreatment prior to quench may not be appropriate, since the high dissolved solids concentrations in waste ammonia liquors are not reduced by conventional treatment means. This dissolved matter is converted to particulates in the atmosphere as water vapor is flashed off. Dirty water quenching is coming under increasing scrutiny of air pollution control agencies, and is likely to become more limited in the future.

There have not been any significant steps taken toward dry coke quenching in this country, despite the use of this technology in the Soviet Union, Japan, England, France, Germany and Switzerland. The current situation in the U.S. is such that plants designed in the immediate future will most likely continue to use water quenching with total recycle of quench water and fresh water makeup. Although all plants in this country practice quenching with water, very few reported any overflows from quenching operations. Quenching wastewaters from by-product and beehive operations are usually recycled to extinction, leaving no wastewaters requiring further treatment. The quality of wastewaters following its use as quench water is shown in Table V-6 for fresh and contaminated waters at by-product coke quenching operations and in Table V-7 for fresh water quenching at beehive operations.

The remaining wastewater sources identified during plant surveys were found at fewer than half of the cokemaking operations. Fourteen by-product cokemaking plants use barometric condensers to create a vacuum in ammonium sulfate crystallizer systems. This operation generates fairly high volumes of contaminated wastewaters. Once-through flows were reported between 83 and 360 l/kkg (20 to 86 gal/ton), but some users practice tight recirculation of crystallizer wastewaters, reducing blowdown rates to 12 to 42 l/kkg (3 to 10 gal/ton). This wastewater is often discharged without treatment, even though considerable concentrations of cyanides are present. Refer to Table V-8 for analytical data on barometric condenser wastewaters. Some plants have installed surface condensers, thus generating only a small wastewater volume.

Another wastewater source requiring treatment is the discharge from wet desulfurizers, which are used by seven plants to recover sulfur compounds from coke oven gas. Again, once-through flows are high, up to 900 l/kkg (216 gal/ton), but recycle is often practiced bringing wastewater blowdown rates down to 50 to 125 l/kkg (12 to 30 gal/ton).

In addition to the foregoing basic flows associated with cokemaking and by-products recovery, additional process waters originate from the use of scrubbers in certain critical operations to eliminate or reduce air pollution emissions. Some of these, notably scrubbers on coal handling, crushing or blending, and coke handling, transfer or screening contribute only minor volumes with easily removable suspended matter as the major pollutant. Other sources generate highly contaminated effluents which require higher levels of treatment. Blowdowns from coal drying and preheating operations are small in volume but contain thousands of mg/l of TSS and volatile organic compounds. Once-through flows average from 250 to 1250 l/kkg (60 to 300 gal/ton), but 95% recycle of such wastewaters provides blowdown volumes of 12 to 63 (3 to 15 gal/ton). Scrubbers on larry cars and other charging equipment generate highly contaminated wastewater with blowdowns ranging from 21 to 104 l/kkg (5 to 25 gal/ton). A recent survey conducted by EPA Region V Eastern District

Office quantified the pollutant concentrations for a typical larry car scrubber system. Analytical data are presented in Table V-9.

The largest single volume of wastewater associated with air pollution controls is that from coke pushing operations. Over 8340 l/kkg (2000 gal/ton) is applied to scrubbing emissions at the pushing side of a coke battery, and even a tight 95% recycle releases up to 420 l/kkg (100 gal/ton) of contaminated wastewater which requires disposal or treatment. Data covering two pushing emission control systems are shown in Table V-10. Note that the concentrations of toxic organics are low when compared with charging emission scrubbers such as the larry car data referred to above.

A summary of average by-product cokemaking process wastewater flows observed during sampling visits and reported in responses to questionnaires is presented in Table V-11. The columns headed "Average of Best" represent the average of up to the best seven of the nine plants sampled and up to the best 20% for questionnaire respondents. This difference in defining "best" reflects the fact that plants selected for sampling were already considered to be superior to most cokemaking plants in some respects. But the presence of minimal treatment or recovery practices at many plants can make interpretation of flow rates misleading. In the by-product cokemaking subdivision, "Best" flow rate may not be the lowest flow demonstrated. Such plants may not have by-product recovery units which generate certain wastewater flows. Sampled plants usually demonstrated superior or unique control and treatment technology and were visited for those reasons, rather than because of minimal flow rates. In fact, the best of the treatment facilties sampled during both phases of this study, Plant 003, was treating the highest process wastewater flow rate.

The applied flow rates for beehive quenching operations were discussed above, and all operating beehive plants have demonstrated an ability to recycle all wastewaters to extinction.

After reviewing the net and gross concentrations of pollutants considered for limitation in the cokemaking subcategory, the Agency concluded the effect of make-up water quality on the various waste streams is minor or negligible. Hence, the effluent limitations and standards are proposed on a gross basis.

TABLE V-1

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN EXCESS AMMONIA LIQUOR(1)

						Mixed Flow(2)
	Reference Code	0112	0384A	0272	Average	0432B
	Plant Code	B	C	D	of 3	A
	Sample Point	1	1	1	-	5
	Flow (Gal/Ton)	27.0	32.6	21.6	27.1	82.7(3)
	Suspended Solids	22	496	30	183	13
	Oils & Greases	37	116	148	100	27
	Ammonia (N)	5030	6822	3715	5189	2635
	Sulfide	1320	203	183	569	15
	Thiocyanate	1070	86	128	428	NA
	pH, (Units)	8.5	6.0-7.9	8.7	6.0-8.7	9.6
117	Beryllium	<0.02	<0.04	NA	<0.03	NA
121	Cyanide	97	96	145	113	75.3
191	Phenolic Compounds	1006	1006	708	907	751

NA: Not Analyzed.

(1) All values are in mg/l unless otherwise noted.
(2) Sample contains wastewaters from benzol plant and final cooler blowdown in addition to excess ammonia liquor.
(3) Flow consists of 49.3 GPT ammonia liquor, 24.9 GPT benzol plant wastewaters, and 8.5 GPT final cooler blowdown.

TABLE V-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN EXCESS AMMONIA LIQUOR(1)

						Mixed Flow(2)
Reference Code		0868A	0920F	0684F	Average of 3	0464C
Plant Code		003	008	009		002
Sample Point(s)		C	B	B	-	B
Flow (Gal/Ton)		27.8	32.5	47.0	35.8	35.9(3)
	Suspended Solids	80	44	97	74	14
	Oils & Greases	184	172	83	146	71
	Ammonia (N)	2387	4375	8255	5006	5067
	Sulfide	439	908	976	774	1833
	Thiocyanate	592	659	680	644	1245
	Phenolic Cpds.	626	1172	1715	1171	702
	pH, (Units)	9.6-9.8	8.8-8.9	8.6	8.6-9.8	9.0-9.1
3	Acrylonitrile	ND	3.3	ND	1.1	4.7
4	Benzene	27.2	5.2	3.4	11.9	2.8
20	2-Chloronaphthalene	ND	ND	ND	ND	0.043
21	2,4,6-Trichlorophenol	ND	ND	ND	ND	0.40
22	Parachlorometacresol	ND	ND	0.014	0.005	4.3
23	Chloroform	1.37	0.47	0.066	0.635	<0.003
34	2,4-Dimethylphenol	5.3	<0.01	ND	1.77	83.7
38	Ethylbenzene	0.64	0.11	ND	0.25	0.29
39	Fluoranthene	3.13	1.51	0.21	1.62	0.98
54	Isophorone	ND	<0.01	ND	<0.003	ND
55	Naphthalene	28.9	35.3	27.5	30.6	10.6
57	2-Nitrophenol	ND	ND	0.08	0.027	1.5
60	4,6-Dinitro-o-cresol	ND	ND	0.09	0.03	0.97
64	Pentachlorophenol	ND	ND	0.40	0.13	ND
65	Phenol	327	413	120	287	666
(4)	Phthalates, Total	2,30	1.81	0.85	1.65	1.98
72	Benzo(a)anthracene	ND	0.015	ND	0.005	*
73	Benzo(a)pyrene	ND	0.197	0.225	0.206	0.51

TABLE V-2
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN EXCESS AMMONIA LIQUOR(1)
PAGE 2

					Average of 3	Mixed Flow(2)
	Reference Code	0868A	0920F	0684F		0464C
	Plant Code	003	008	009		002
	Sample Point(s)	C	B	B	-	B
	Flow (Gal/Ton)	27.8	32.5	47.0	35.8	35.9(3)
76	Chrysene	ND	0.32	0.07	0.13	*
77	Acenaphthylene	6.4	5.7	4.2	5.4	3.2
78	Anthracene	*	*	*	*	*
79	Benzo(ghi)perylene	0.03	ND	ND	0.01	0.003
80	Fluorene	2.5	0.70	0.37	1.19	0.77
81	Phenanthrene	*	*	*	*	*
84	Pyrene	2.6	0.71	0.16	1.16	0.82
86	Toluene	8.9	2.1	0.443	3.8	0.91
130	Xylene	0.01	ND	55	18.3	<0.01
114	Antimony	NA	0.24	0.40	0.32	0.033
115	Arsenic	NA	0.66	0.21	0.43	0.267
117	Beryllium	<0.001	<0.001	NA	<0.001	<0.002
120	Copper	0.017	0.017	0.065	0.033	0.100
121	Cyanides	22.3	28.6	25.9	25.6	21.5
124	Nickel	<0.005	<0.005	NA	<0.005	0.065
125	Selenium	NA	2.6	0.13	1.36	0.457
126	Silver	<0.001	<0.001	<0.02	<0.007	<0.025
128	Zinc	0.13	0.47	NA	0.30	0.241

NA: Not analyzed.
ND: None detected.
* : Compound could not be separated, but is present in sample.

(1) All values are in mg/l unless otherwise noted.
(2) Sample contains wastewaters from final cooler blowdown in addition to excess ammonia liquor.
(3) Flow consists of 29.9 GPT excess ammonia liquor and 6.0 GPT final cooler blowdown.
(4) Value shown is the sum of all values for the following phthalates: 66 Bis-(2-ethylhexyl); 67 Butylbenzyl; 68 Di-n-butyl; 69 Di-n-octyl; 70 Diethyl and 71 Dimethyl phthalate.

TABLE V-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN FINAL COOLER BLOWDOWNS(1)

Reference Code		0732A
Plant Code		001
Sample Point(s)		C-A
Flow, (Gal/Ton)		70.5
	Suspended Solids	29
	Oils & Grease	28
	Ammonia (N)	30
	Sulfide	22
	Thiocyanate	52
	Phenolic Compounds	101
	pH, (Units)	7.3
3	Acrylonitrile	1.5
4	Benzene	37.3
35	2,4-Dinitrotoluene	1.87
36	2,6-Dinitrotoluene	0.236
39	Fluoranthene	1.09
54	Isophorone	4.00
55	Naphthalene	39.0
65	Phenol	59.7
(2)	Phthalates, Total	1.44
72	Benzo(a)anthracene	0.107
73	Benzo(a)pyrene	0.080
76	Chrysene	0.053
77	Acenaphthylene	0.323
80	Fluorene	0.156
84	Pyrene	0.080
86	Toluene	17.0
114	Antimony	<0.003
115	Arsenic	0.006
117	Beryllium	<0.002
120	Copper	<0.004
121	Cyanides	188
125	Selenium	<0.005
126	Silver	<0.025
128	Zinc	0.08

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(1) All values are in mg/l unless otherwise noted.

(2) Value shown is the sum of all values for the following phthalates: 66 Bis-(2-ethylhexyl); 67 Butylbenzyl; 68 Di-n-butyl; 64 Di-n-octyl; 70 Diethyl and 71 Dimethyl phthalate.

TABLE V-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN FINAL COOLER BLOWDOWNS(1)

		Mixed Flow(2)	Mixed Flow(3)	Average of Two Mixed Samples
	Reference Code	0112	0384A	
	Plant Code	B	C	
	Sample Point(s)	4-3	3-4	-
	Flow, (Gal/Ton)	100(4)	448(5)	274 64 FCBD 62 Benzol Plt. 148 Quench Recycle
	Suspended Solids	40	(11)(6)	40
	Oils & Greases	293	84	189
	Ammonia (N)	107	92	100
	Sulfide	443	135	289
	Thiocyanate	7.4	10	8.7
	pH (Units)	8.0	8.5	8.0-8.5
117	Beryllium	<0.02	<0.04	<0.03
121	Cyanides	118	51	84
191	Phenolic Cpds.	178	150	164

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(1) All values are in mg/l unless otherwise noted.

(2) Sample contains wastewaters from benzol plant in addition to final cooler blowdowns.

(3) Sample contains wastewaters from benzol plant in addition to final cooler blowdowns, and is the runoff to a sump following use as quench water.

(4) Flow consists of 82.5 GPT final cooler blowdown and 17.5 GPT of benzol plant wastewaters.

(5) Flow consists of 45.5 GPT final cooler blowdown and 107 GPT of benzol plant wastewaters and 296 GPT of recycled quench.

(6) Non-representative sample for suspended solids, which were conveyed along the bottom of the sampling sluiceway.

TABLE V-5

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN BENZOL PLANT WASTEWATERS(1)

	Reference Code	0920F(2)	0684F	Average of 2
	Plant Code	008	009	
	Sample Point(s)	D-(A+C)	G-A	-
	Flow, (Gal/Ton)	23.4	49.7	36.6
	Suspended Solids	95	75	85
	Oils & Greases	38	166	102
	Ammonia (N)	366	187	276
	Sulfide	-	79	40
	Thiocyanate	264	239	252
	Phenolic Compounds	127	455	291
	pH (Units)	7.8	8.4-8.5	7.8-8.5
1	Acenaphthene	0.150	0.005	0.078
3	Acrylonitrile	2.07	1.45	1.76
4	Benzene	74.5	85.5	80.0
34	2,4-Dimethylphenol	5.97	ND	2.78
38	Ethylbenzene	0.654	<0.005	0.33
39	Fluoranthene	0.232	0.95	0.59
55	Naphthalene	5.31	27.5	16.4
64	Pentachlorophenol	ND	1.16	0.58
65	Phenol	75.8	40.0	57.9
(3)	Phthalates, Total	-	12.42	6.21
72	Benzo(a)anthracene	NA	1.20	0.60
76	Chrysene	-	1.49	0.75
77	Acenaphthylene	-	1.19	0.60
78	Anthracene	*	ND	*
80	Fluorene	0.195	0.175	0.185
81	Phenanthrene	*	ND	*
84	Pyrene	-	1.05	0.53
86	Toluene	10.1	11.5	10.8
130	Xylene	ND	145.0	72.5
114	Antimony	-	<0.1	<0.05
115	Arsenic	-	0.055	0.028
117	Beryllium	<0.01	NA	<0.01
118	Cadmium	0.006	<0.01	<0.01
119	Chromium	0.005	NA	0.005
120	Copper	-	0.02	0.01
121	Cyanides	-	0.025	0.013
122	Lead	-	<0.05	<0.025
126	Silver	1.89	<0.02	0.95

NA: Not analyzed.
ND: None detected.
- : Calculation resulted in negative value for net concentration, and is equivalent to ND.
* : Compound could not be separated, but is present in sample.

(1) All values are in mg/l unless otherwise noted.
(2) Concentration is calculated by difference from other sampling points.
(3) Value shown is the sum of all values for the following phthalates: 66 Bis-(2-ethylhexyl) 67 Butylbenzyl; 68 Di-n-butyl; 69 Di-n-octyl, 70-Diethyl and 71-Dimethylphthalate.

TABLE V-6

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATION OF POLLUTANTS IN WASTEWATERS FROM QUENCHING(1)

	Fresh Water Make-up	Contaminated Water(2) Make-up
Reference Code	0384A	0384A
Plant Code	C	C
Sample Point(s)	5-4	3-4
Flow (Gal/Ton)	498	448(3)
Suspended Solids	703	(11)(4)
Oils & Greases	9.6	84
Ammonia (N)	1.94	92
Sulfide	<0.02	135
Thiocyanate	<3	10
pH (Units)	7.6	8.5
117 Beryllium	<0.04	<0.04
121 Cyanides	4.0	51
191 Phenolic Cpds.	1.46	150

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(1) All values are in mg/l unless otherwise noted.
(2) Sample contains wastewaters from benzol plant and from final cooler blowdowns.
(3) Flow consists of 45.4 GPT final cooler discharge, 107 GPT benzol plant wastewater, and 296 GPT of recycled quenchwaters.
(4) Non-representative sample for suspended solids, which were conveyed along the bottom of the sampling sluiceway.

TABLE V-7

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BEEHIVE COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN WASTEWATERS FROM QUENCHING(1)

Plant Code		E	F	G	Average of 3
Sample Point(s)		3-5	1-(2+5)	1-(2+3+4)	
Flow (Gal/Ton)		490	490	123	368
	Suspended Solids	165	29	713	302
	Oils & Greases	<1	<1	3.7	<1.9
	Ammonia (N)	0.27	-	-	0.09
	Sulfide	<0.02	<0.02	<0.02	<0.02
	Thiocyanate	<3	<3	-	<2
	pH (Units)	7.3	7.3	7.0-7.3	7.0-7.3
117	Beryllium	<0.02	<0.02	<0.02	<0.02
121	Cyanide	0.002	<0.002	<0.002	<0.002
123	Mercury	0.0031	-	0.0026	0.0019
191	Phenolic Compounds	0.011	<0.01	<0.002	<0.008

- : Calculation resulted in negative value for net concentrations, and is equivalent to ND.

(1) All values are in mg/l unless otherwise noted.

TABLE V-8

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELIENS STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN CRYSTALLIZER BAROMETRIC CONDENSER WASTEWATER(1)

	Reference Code	0432B
	Plant Code	A
	Sample Point(s)	4-3
	Flow, (Gal/Ton)	56.6
	Suspended Solids	35
	Oils & Greases	8.5
	Ammonia (N)	0.27
	pH (Units)	8.7
117	Beryllium	<0.02
121	Cyanide	138
191	Phenolic Compounds	2.72

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(1) All values are in mg/l unless otherwise noted.

TABLE V-9

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANT
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN LARRY CAR SCRUBBER BLOWDOWNS(1)

Reference Code		0584B
Flow (Gal/Ton)		24.2
	Suspended Solids	9218
	Oils & Greases	17.5
	Ammonia (N)	9.42
	Sulfide	<0.25
	Thiocyanate	<0.50
	Phenolic Cpds.	7.54
	pH (Units)	4.0
4	Benzene	0.050
34	2,4-Dimethylphenol	0.040
38	Ethylbenzene	<0.010
39	Fluoranthene	0.68
55	Naphthalene	0.27
65	Phenol	1.72
68	Di-n-butyl phthalate	<0.010
72	Benzo(a)anthracene*	<0.64
73	Benzo(a)pyrene	0.31
75	Benzo(k)fluoranthene	0.40
76	Chrysene*	<0.64
77	Acenaphthylene	0.45
78	Anthracene*	<1.04
81	Phenanthrene*	<1.04
82	Dibenzo(a,h)anthracene	0.11
83	Indeno(1,2,3-dc)pyrene	0.18
84	Pyrene	0.55

TABLE V-9
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANT
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN LARRY CAR SCRUBBER BLOWDOWNS(1)
PAGE 2

114	Antimony	<0.001
115	Arsenic	0.244
117	Beryllium	<0.010
118	Cadmium	0.010
119	Chromium	0.020
120	Copper	0.010
121	Cyanides	0.50
122	Lead	0.050
123	Mercury	<0.001
124	Nickel	0.036
125	Selenium	<0.005
126	Silver	<0.006
127	Thallium	<0.05
128	Zinc	0.09

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(1) All values are in mg/l unless otherwise noted.

* Compound could not be separated, but is present in sample.

TABLE V-10

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS
IN PUSHING EMISSION CONTROL SYSTEM BLOWDOWNS(1)

		One-Spot Push & Quench Car	Stationary Emission Control System
Reference Code		0684F	0320
Flow (Gal/Ton)		70.0	43.5
	Suspended Solids	2260	2032
	Oils & Greases	<1	2
	Ammonia (N)	2.15	0.51
	Sulfide	<0.16	<0.25
	Thiocyanate	0.10	<0.50
	Phenolic Cpds.	0.381	0.33
	pH (Units)	6.5	4.6-7.1
4	Benzene	<0.010	-
23	Chloroform	<0.010	ND
24	2-Chlorophenol	ND	<0.010
34	2,4-Dimethylphenol	ND	0.020
37	1,2-Diphenylhydrazine	<0.010	ND
39	Fluoranthene	0.011	<0.010
44	Methylene Chloride	0.017	-
55	Naphthalene	<0.010	<0.010
65	Phenol	<0.010	0.070
66	Bis(2-ethylhexyl) phthalate	<0.010	-
67	Butyl benzyl phthalate	<0.010	ND
68	Di-n-butyl phthalate	<0.010	ND
69	Di-n-octyl phthalate	<0.010	ND
70	Diethyl phthalate	<0.010	ND
71	Dimethyl phthalate	<0.010	ND
72	Benzo(a)anthracene*	<0.010	<0.010
73	Benzo(a)pyrene	<0.010	ND
75	Benzo(k)fluoranthene	<0.010	ND
76	Chrysene*	<0.010	<0.010
77	Acenaphthylene	<0.010	<0.010
78	Anthracene*	<0.010	0.010
79	Benzo(ghi)perylene	<0.010	ND
80	Fluorene	<0.010	<0.010
81	Phenanthrene*	<0.010	0.010
82	Dibenzo(a,h)anthracene	<0.010	ND
83	Indeno(1,2,3-cd)pyrene	<0.010	ND
84	Pyrene	0.013	<0.010

TABLE V-10
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS
IN PUSHING EMISSION CONTROL SYSTEM BLOWDOWNS(1)
PAGE 2

		One-Spot Push & Quench Car	Stationary Emission Control System
114	Antimony	NA	<0.001
115	Arsenic	NA	0.017
117	Beryllium	0.002	<0.010
118	Cadmium	0.003	<0.010
119	Chromium	0.147	0.010
120	Copper	0.238	0.020
121	Cyanides	0.235	0.015
122	Lead	0.09	0.010
123	Mercury	-	<0.001
124	Nickel	0.178	ND
125	Selenium	NA	0.010
126	Silver	<0.003	<0.006
127	Thallium	NA	<0.050
128	Zinc	0.164	0.060

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(1) All values are in mg/l unless otherwise noted.

- : Calculation of net concentration yields negative number, due to higher level in make-up water.
* : Compound could not be separated, but is present in sample.
ND: None detected.
NA: Not analyzed.

TABLE V-11

SUMMARY OF PROCESS WASTEWATER FLOW RATES FOR BY-PRODUCT COKEMAKING OPERATIONS

(All flows are listed in Gallons per Ton (GPT) of coke produced.)

Wastewater Sources	Data Source			
	Plant Sampling Visits		Questionnaire Responses	
	Average of All	Average of "Best"	Average of All	Average of "Best"
Waste Ammonia Liquor	36.1 (9)	31.2 (7)	41.1 (56)	22.8 (12)
Final Cooler Blowdown	39.6 (5)	7.5 (2)	49.3 (22)	4.4 (5)
Benzol Plant Wastes	39.6 (8)	23.4 (4)	47.5 (24)	17.2 (5)
Miscellaneous Wastes	35.0 (4)	20.2 (3)	87.7* (8)	18.3 (2)
Steam Condensates	11.7 (6)	9.4 (4)	9.5 (47)	8.0 (9)
Subtotal - Basic Flow	162.0	91.7	235.1*	70.7
Baro. Condenser Blowdown	56.6 (1)**	56.6 (1)**	27.6 (10)	1.4 (2)
Desulfurizer, wet	19.6 (2)	19.6 (2)	28.7 (6)	14.0 (2)
Air Pollution Control Blowdowns:				
Preheaters and Dryers	-	-	66.5 (6)	4.8 (1)
Charging	14.8 (2)	5.4 (1)	198.0 (15)	4.8 (3)
Pushing	167.2 (3)	56.8 (2)	148.5 (15)	71.6 (3)

( ): Numbers in parentheses indicate the number of plants used in "average" calculation.
* : Flows include varying amounts of non-contact cooling water. Segregation would reduce flow shown.
** : Flow from a once-through operation.

COKEMAKING SUBCATEGORY

SECTION VI

WASTEWATER POLLUTANTS

Introduction

The originally promulgated regulation established limitations for by-product cokemaking operations for ammonia-N, cyanides, oil and grease, phenolic compounds, suspended solids, and pH. The Agency found other pollutants in the wastewaters in significant quantities (e.g., chlorides, sulfates, sulfides, dissolved solids), but did not establish specific limitations for those pollutants.

Conventional Pollutants

In the originally promulgated regulation, the Agency established limitations for three conventional pollutants (TSS, oil and grease, and pH). Suspended solids originate, in part, as particles of condensed tars, naphthalene crystals and bits of fine coal or coke which are carried out with coke oven gas, and then subsequently trapped in flushing liquor. An even larger load of suspended solids results when lime is added to strip fixed ammonia out of wastewaters. Unreacted lime is the major component of the suspended solids in by-product coke plant wastewaters, while coke fines make up the bulk of suspended solids in beehive wastewaters. Biological treatment of cokemaking wastewaters also generates suspended solids.

Oils and greases are among the numerous products formed during the destructive distillation of coal, along with the other organic pollutants described below. These oils and greases are not the typical lubricating oils found in other steel industry subcategories, but are organic compounds which are extracted by the solvents used in this analytical procedure.

The proposed limitations regulate wastewater pH routinely in all subcategories, principally because of the environmentally detrimental impacts which occur due to extremes in pH. By-product cokemaking wastewater typically is alkaline in its raw state due high levels of ammonia in solution. The pH is raised even further (to 10-12 standard units) for ammonia distillation, thus the wastewaters require neutralization prior to discharge.

Toxic Pollutants

Two of the pollutants which the Agency has traditionally established limitations for in the steel industry are toxic pollutants (cyanide and phenolic compounds). It should be noted that measurement of phenolic compounds includes most of the toxic phenol-based compounds. The Agency believes that by establishing limitations for phenolic compounds, the levels of these toxic pollutants in the wastewaters are controlled effectively.

In addition, the Agency employed sophisticated analytical techniques to evaluate the presence, absence, or magnitude of each of 115 organic and 15 nonorganic toxic pollutants in the process wastewaters.

Most of the toxic pollutants found in by-product cokemaking wastewaters are products of the destructive distillation of coal. Additional sampling, specifically designed to provide data for the toxic pollutants, confirmed the presence of 41 toxic organic and 14 toxic metal pollutants. Refer to Table VI-1 for a summary of all toxic pollutants found in cokemaking wastewaters. Since the original limitations required "no discharge of process wastewater pollutants" from beehive operations, the Agency did not include them in the toxic pollutant survey. The data presented for beehive cokemaking were gathered during the original guidelines study.

Twenty of the toxic pollutants shown in Table VI-1 were observed at relatively low concentrations (0.01 to 0.02 mg/l) at only one coke plant. The overall list was shortened by deleting such pollutants. The remaining 35 toxics appeared to be more characteristic of the raw wastewaters from by-product cokemaking operations.

Based on their presence in untreated wastewaters from cokemaking, the Agency considered establishing limitations for the following 29 organic and 6 nonorganic pollutants:

TOXIC ORGANIC POLLUTANTS

Acrylonitrile
Benzene
2,4,6-Trichlorophenol
Parachlorometacresol
Chloroform
2,4-Dimethylphenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Ethylbenzene
Fluoranthene
Isophorone
Naphthalene
4,6-Dinitro-o-cresol
Pentachlorophenol
Phenol
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Diethyl phthalate
Dimethyl phthalate
Benzo(a)anthracene
Benzo(a)pyrene
Chrysene
Acenaphthylene
Pyrene
Fluorene
Toluene
Xylene

TOXIC METAL POLLUTANTS AND CYANIDE

Antimony
Arsenic
Cyanide
Selenium
Silver
Zinc

The Agency found methylene chloride at high levels in all of the wastewater samples from one plant. The Agency decided not to consider proposing limitations for that pollutant since its detection probably resulted from contamination while cleaning sampling devices or laboratory glassware, and not from the cokemaking process. Also, there is evidence that the phthalates found in certain samples might be an artifact of the sampling procedure which leached out of plastic tubing used to collect samples automatically. However, as the phthalates were also found in wastewater samples which were collected manually, the Agency believes that it is a constituent of cokemaking wastewaters. Refer to Table VI-2 for data on the individual phthalates found in each by-product cokemaking sample. It should be noted that where high pH and elevated temperatures tended to occur, the highest levels of phthalates were found. These were raw and intermediate level wastewater samples. But this was the case whether the sample was collected automatically or manually, so even if leaching occurred for automatic samples, high phthalates were found in others where no contact with plastics occurred (e.g., Sample C at Plant 008).

The Agency found that the six individual phthalates were present at varying levels at the five coke plants, with no discernible pattern, except that bis(2-ethylhexyl) and di-n-butyl were most often found, and diethyl and dimethyl the least prevalent. But for a given plant, (e.g., 009) diethyl or dimethyl phthalate could be found at higher concentrations than the more common ones. As discussed later in this report, removal of other toxic organics that are limited should insure control of phthalates.

Other Pollutants

One other major pollutant, ammonia-N, has been universally found in wastewater from by-product recovery cokemaking operations at extremely high levels. The originally promulgated BPT regulation contained Ammonia-N limitations, as does this proposed regulation. Ammonia is found at high concentrations in raw by-product recovery cokemaking wastewaters, is acutely toxic to aquatic life at relatively low levels, and exerts a significant oxygen demand upon receiving streams.

The Agency considered establishing limitations for two additional nontoxic pollutants: thiocyanates and sulfides. Thiocyanates are present in coke plant wastewaters, and have a potential for breaking down into cyanides and sulfides under proper conditions. Sampling data obtained during coke plant visits provides a basis for establishing limitations for thiocyanates. However, long term data for existing treatment facilities also indicate that the level of this pollutant is adequately controlled incidentally, when certain other pollutants, for which the Agency is proposing limitations, are adequately treated. The same is true of sulfides. Biological treatment systems achieve sulfide levels of fractions of a mg/l. Accordingly, the Agency is not proposing limitations for this pollutant.

Additional wastewater characteristics and pollutants studied in by-product cokemaking operations include acidity/alkalinity, aluminum, barium, boron, calcium, carbon, chloride, cobalt, hardness, iron, magnesium, manganese, molybdenum, nitrate, potassium, silica, sodium, solids (dissolved and volatile), sulfate, tin, titanium, vanadium and ytterbium. These data are available in a supplement to this report. Based upon levels of these pollutants found in cokemaking wastewaters, or their nontoxic characteristics, the Agency is not proposing limitations for them.

Selected Wastewater Pollutants

The Agency is proposing limitations for those pollutants which it considers to be most representative of the pollutants found in cokemaking wastewaters. These pollutants are shown in Table VI-3. These include the pollutants which were included in the original BPT limitations, and for by-product cokemaking, three additional toxic organic pollutants which are limited by the proposed BAT limitations.

The Agency recognizes that if it were to propose limitations for each toxic pollutant shown above or in Table VI-1, the monitoring burden and analytical costs that would be imposed on the industry would be excessive. For this reason, the Agency reviewed analytical data to determine if certain pollutants acted as "indicators" for groups of other pollutants found in the wastewater. A specific discussion on the use of "indicator" pollutants is found in Volume I. Based upon its review, the Agency concludes that certain pollutants do act as "indicators" for other pollutants. As the list of pollutants found in the wastewater contains 6 volatile, 6 acid extractable and 17 base/neutral toxic organics among the 29 listed pollutants, benzene was selected to indicate the presence of volatiles, the 4-AAP phenolic compounds pollutants to indicate the presence of acid extractable, and naphthalene and benzo(a)pyrene to indicate the presence of base/neutral compounds. Available data indicate that effective treatment for these indicator pollutants results in comparable reductions or the elimination of the remaining 25 toxic organic pollutants.

TABLE VI-1

TOXIC POLLUTANTS KNOWN TO BE PRESENT COKEMAKING SUBCATEGORY

By-product Cokemaking Operations

Toxic Pollutant Number	Pollutant Parameter	Toxic Pollutant Number	Pollutant Parameter
1	Acenaphthene	72	Benzo(a)anthracene
3	Acrylonitrile	73	Benzo(a)pyrene
4	Benzene	75	Benzo(k)fluoranthene
20	2-Chloronaphthalene	76	Chrysene
21	2,4,6-Trichlorophenol	77	Acenaphthylene
22	Parachlorometacresol	78	Anthracene
23	Chloroform	79	Benzo(ghi)perylene
24	2-Chlorophenol	80	Fluorene
34	2,4-Dimethylphenol	81	Phenanthrene
35	2,4-Dinitrotoluene	82	Dibenzo(a,h)anthrancene
36	2,6-Dinitrotoluene	83	Indeno(1,2,3-cd)pyrene
37	1,2 Diphenylhydrazine	84	Pyrene
38	Ethylbenzene	86	Toluene
39	Fluoranthene	114	Antimony
44	Methylene Chloride	115	Arsenic
54	Isophorone	117	Beryllium
55	Naphthalene	118	Cadmium
57	2-Nitrophenol	119	Chromium
60	4,6-Dinitro-o-cresol	120	Copper
64	Pentachlorophenol	121	Cyanide
65	Phenol	122	Lead
66	Bis-(2-ethylhexyl)phthalate	123	Mercury
67	Butyl Benzyl Phthalate	124	Nickel
68	Di-n-butyl Phthalate	125	Selenium
69	Di-n-octyl Phthalate	126	Silver
70	Diethyl Phthalate	127	Thallium
71	Dimethyl Phthalate	128	Zinc
		130	Xylene

Beehive Cokemaking Operations

65	Phenol(191 Phenolic Cpds.)	121	Cyanides
117	Beryllium	123	Mercury

TABLE VI-2

PHTHALATES FOUND IN BY-PRODUCT COKEMAKING SAMPLES

Plant Code	Sample			#66 Bis (2-ethylhexyl) Phthalate	#67 Butyl Benzyl Phthalate	#68 Di-n-butyl Phthalate	#69 Di-n-octyl Phthalate	#70 Diethyl Phthalate	#71 Dimethyl Phthalate	pH	Temp °F
	No.	Source	Type								
001	A	F	M	<0.007	<0.007	0.004	0.003	ND	ND	7.2	40
	B	F	M	<0.063	<0.003	<0.017	0.004	ND	1.23	7.2	41
	C	R	M	ND	0.080	0.067	0.080	ND	1.23	7.3	81
	D	R	A	0.122	0.117	ND	ND	0.143	0.307	7.6	67
002	A	F	M	ND	0.01	0.060	ND	ND	0.950	7.9	73
	B	R	M	0.152	ND	1.713	0.115	ND	ND	9.0	122
	C	I	M	3.27	0.993	0.130	0.008	ND	0.007	9.0	115
	D	E	M	0.183	0.600	1.080	0.007	ND	ND	8.9	101
003	A	F	M	<0.031	<0.003	<0.003	<0.010	ND	ND	6.3	60
	B	F	M	<0.121	<0.003	<0.003	0.005	ND	ND	7.0	54
	C	R	M	1.81	0.127	ND	0.036	ND	ND	9.7	137
	D	I	A	13.370	2.933	4.013	0.117	ND	ND	11.3	147
	E	E	A	0.026	<0.046	0.019	0.083	ND	0.018	7.4	69
	F	E	A	<0.041	<0.007	<0.012	0.004	ND	ND	7.2	78
	G	F	M	<0.011	<0.003	<0.003	ND	ND	ND	7.7	52
	P	E	M	0.118	0.010	<0.010	<0.010	<0.010	ND	7.2	64
008	A	F	M	0.013	ND	ND	ND	ND	ND	7.6	88
	B	R	M	0.977	0.143	0.670	<0.020	ND	ND	8.8	154
	C	R	M	4.600	0.510	3.463	4.333	ND	ND	10.6	200
	D	I	M	0.488	0.200	0.283	0.263	0.220	2.503	9.5	143
	E	E	A	1.669	<0.003	0.282	1.567	0.010	0.006	7.6	85
009	A	R	M	<0.010	ND	ND	ND	ND	ND	7.7	79
	B	I	M	0.185	ND	0.155	ND	0.142	0.370	8.6	142
	C	I	M	0.750	ND	0.250	ND	0.650	3.500	8.7	121
	D	I	M	0.450	ND	0.145	ND	0.457	2.850	8.7	119
	E	I	M	<0.010	<0.010	<0.010	ND	<0.005	<0.005	8.7	115
	F	E	M	<0.010	ND	0.010	ND	<0.005	ND	9.0	198
	G	R	M	ND	ND	2.913	ND	3.250	6.265	8.5	106
	H	I	M	0.008	ND	0.105	ND	ND	0.279	9.8	95
	I	I	M	0.013	ND	0.084	ND	0.100	<0.022	9.7	95
	J	E	M	0.196	ND	<0.005	0.135	<0.005	<0.005	9.9	92

Key to Sample Source
- F - Fresh Water Makeup (River, lake, or city water)
- R - Raw Wastewater - before treatment
- I - Intermediate Wastewater - partially treated
- E - Treated Effluent

Key to Sample Type:
- M - Manually Collected
- A - Automatically Collected

TABLE VI-3

SELECTED WASTEWATER POLLUTANTS
COKEMAKING SUBCATEGORY

A. By-Product Recovery Processes:

Pollutant Parameter		Regulated in the Originally Promulgated BPT Level	Proposed For Regulation at BAT
	Suspended Solids	X	X
	Oil and Grease	X	X
	Ammonia-N	X	X
	pH	X	X
4	Benzene		X
55	Naphthalene		X
73	Benzo(a)pyrene		X
121	Cyanides, Total	X	X
191	Phenolic Compounds (4-AAP Method)	X	X

B. Beehive Process(1)

	Suspended Solids	X	X
	Ammonia	X	X
	pH	X	X
121	Cyanides, Total	X	X
191	Phenolic Compounds (4-AAP Method)	X	X

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(1) For Beehive processes, BPT and BAT regulations require "no discharge of process wastewater pollutants to navigable waters." This in effect controls all potential pollutants, not merely the five pollutants shown.

COKEMAKING SUBCATEGORY

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Introduction

A brief summary of the treatment practices employed at all twelve plants visited during this study demonstrates the variations in treatment techniques employed in this subcategory. A summary of the technology employed within the entire subcategory is also presented. Included are descriptions of the control and treatment technology as applied in cokemaking and more detailed discussions of technology used to treat or control specific pollutants.

Summary of Treatment Practices Currently Employed

Wastewater treatment at beehive coke plants is relatively simple, since the only waste flow requiring control is excess water applied during coke quenching. Treatment consists of one or more sedimentation basins to recover the coke fines, which are then returned to the coking process. Water which overflows the basins is recycled to extinction as quench water, with the result that no wastewater is discharged.

For by-product coke plants, many factors influence the choice of wastewater control and treatment alternatives. The many recovery practices reported in Section III are indicative of the possible combinations found in this subcategory. Similarly, the wastewater control and treatment techniques practiced at operating coke plants demonstrate variations unique to this subcategory, yet the best of these tend to achieve similar quality effluent loads. These treatment systems incorporate physical/chemical controls, biological treatment, or combinations thereof. Some operators treat the wastewater sufficiently to produce acceptable effluent quality prior to discharge while others currently provide only limited pretreatment in order that their wastes might be acceptable to local publicly-owned treatment works. These latter discharges, although usually lower in flow, contain considerably higher levels of pollutants than do the direct effluent discharges, since additional treatment is provided at the POTW. Sixteen by-product coke plants have attained zero discharge of process wastewaters by disposing of wastewaters in quenching operations or through oxidative incineration, but both practices have limited potential for wide application because of the impact on air quality.

A summary of the control and treatment technology currently practiced at by-product cokemaking operations follows:

1. The by-product recovery system itself controls the level of pollutants discharged since the by-products recovered would

otherwise be part of the raw waste load if excess ammonia liquor was discharged untreated. Recoveries practiced include:

a. Crude coal tar - coal tar from flushing liquor loops and primary coolers is collected for resale or further processing on or off-site. Crude coal tar is recovered at all by-product coke plants.

b. Crude light oils - light oils are scrubbed from the coke oven gas, recovered for resale, reuse as a solvent for phenolics, or for further refining on or off-site.

c. Ammonia and ammonium compounds - free ammonia is steam stripped from excess ammonia liquors at most plants. Of those plants with ammonia stills, about half also recover fixed ammonia by elevating the pH of the wastewaters with lime slurry or caustic soda solutions. The liberated ammonia is scrubbed back out of the coke oven gas stream using sprays of sulfuric or phosphoric acid in an absorber (semi-direct recovery, practiced at 46 plants), or by scrubbing ammonia from gas with fresh water, which is recirculated to produce concentrated ammonium hydroxide (indirect recovery, practiced at 6 plants).

d. Phenol, phenolates and carbolates - between one-third and one-half of operating coke plants practice dephenolization, either by vapor recirculation or liquid/liquid extraction with suitable solvents. In vapor recirculation, the steam leaving the free leg of the ammonia still is scrubbed with dilute caustic soda to form sodium phenolates. This steam recirculates to the ammonia stills again for further treatment and recovery. In solvent extraction, the benzol, light oil, or other suitable solvent extracts phenolics compounds from the wastewater, is separated and then the phenolized solvent itself is extracted with the caustic. Again, sodium phenolates separate out, and the dephenolized solvent is reused in the recovery system.

e. Sulfur and sulfur compounds - eight of the larger coke plants, representing 34% of the coke production capacity in the United States, now practice desulfurization of coke oven gas to clean the gas for subsequent reuse and to recover elemental sulfur or sulfur compounds, e.g., ammonium sulfate. Techniques developed include iron oxide boxes using Fe_2O_3 on wood shavings; absorption and desorption with soda ash; Wilputte vacuum carbonate system; Seaboard actified solution system; Claus sulfur recovery systems; and a Takahax absorption/Hirohax sulfur recovery system.

f. Naphthalene - This compound is recovered at about 70 percent of the by-product coke plants. Crystals of naphthalene condensed in the final cooler are recovered from the recirculating final cooler wastewater by skimming, filtration or centrifugation. Most of the plants recovering naphthalene take all crystals which solidify below 74°C

(165°F). However, one plant cyrstallizes at temperatures between 74C° and 79C° (165° to 174°F), and two plants differentiate between naphthalenes solidifying above or below 74°C (165°F), and recover both fractions separately.

g. Other by-products - recovery of additional by-products is normally related to the further refinement of products recovered above in cruder mixtures, or in alternative approaches to the basic recovery techniques which lead to other forms. For example, instead of recovering ammonia as a sulfate, phosphate, or hydroxide, one plant is designed to convert ammonia into anhydrous ammonia, readily usable as fertilizer or for other chemical processes. Specialized recoveries at that same plant include cresols, cresylic acid, and picolines.

2. Once these various levels of by-product recovery are accomplished, contaminated wastewater remains which requires treatment before discharge. Again, a variety of options exist for each configuration found at by-product coke plants.

The general practice is described below:

a. Recovery of free ammonia from excess ammonia liquor only. This step is considered to be by-product recovery, and is not included in pollution control costs.

b. Dephenolization of weak ammonia liquor, benzol plant wastes, and final cooler blowdowns in the physical/chemical system only. As in the case of free ammonia stills, this step is considered to be by-product recovery, and is not included in costing. Where dephenolizers exist at plants with biological treatment systems, they are usually inactive.

c. Sedimentation of dephenolized wastes, miscellaneous wastewaters and once-through crystallizer wastewaters, if any, in a settling pond.

d. Recycle of coke quenching wastewaters to extinction, with no runoffs. Makeup to quench system is fresh water only, or fresh water plus air pollution emission control scrubber blowdowns, if any.

3. Biological Treatment

a. Assuming the above starting point, the first additional step is the addition of a fixed leg to the ammonia still, with provision for adding a lime slurry or caustic soda solution and additional steam. This step effectively strips more ammonia from wastewaters. The resulting high pH wastewaters are again neutralized with acid. A few bio-oxidation treatment plants omit stripping fixed ammonia, and use a two or three to one dilution to bring ammonia down to a level which will not inhibit biological activity. However, this practice results in excessive flows and higher pollutant loads in plant effluents.

b. A single stage activated sludge bio-oxidation system is provided to treat neutralized still wastes. Dephenolizers are often abandoned at this point, since biological treatment tends to control phenolic compounds effectively even in a single stage system. Aeration is provided by mechanical agitation or through the use of large blowers.

c. Advanced bio-oxidation systems incorporate a second stage of biological treatment, or provide for extended oxidation in one stage. The sludge (organisms) in the two stage system may be collected and recycled separately at each stage, or collected after the second stage and recycled to the first aeration basin as practiced at plant 003. The effluents from these multi-stage biological reactors are further treated by sedimentation in a clarifier and, where necessary, pH adjustment. A possible sequence involves phenol removal in the first of three stages, cyanide and ammonia oxidation to nitrites and nitrates in a second stage, then denitrification in a final stage prior to aeration and discharge. Systems observed during the field surveys incorporate single stage and two stage bio-oxidation reactors. All used varying degrees of dilution water, although several operate without dilution for months at a time. Also, a noncontact cooling system has been installed at one plant to control temperature, a critical factor in treatment plant operations. As a result, dilution water has been essentially eliminated at this plant.

As an alternate to the above systems, a single stage activated sludge system can be operated with high sludge age to produce comparable effluent quality. This alternative would not require any major capital modifications to the biological systems currently installed in the industry. However, changes in operating practice will be required. At this time sufficient data is not available to fully assess the feasibility of single-stage activated sludge systems. The Agency will be evaluating data from several pilot studies and from a full-scale system to determine whether single-stage biological systems should be used as a basis for establishing BAT limitations.

d. A system which adds powdered activated carbon to a single stage bio-oxidation system is currently being tested to determine the degree of effluent reduction attainable. Benefits are anticipated in improved organic and solids removals, elimination of an otherwise objectionable color from plant effluents, enhanced oxidation and nitrification rates, and increased stability under shock loads.

e. A final polish by filtration provides significant improvement in total suspended solids removal. Deep bed, mixed media pressure filter systems are demonstrated in this application.

4. Physical/Chemical Configuration

a. Assuming the level of treatment described in Paragraph 2, including a dephenolizer, the first level of additional technology includes a fixed leg on the ammonia still with provisions for adding lime slurry and additional steam to strip fixed ammonia from the wastewater. Since a high pH results from this treatment, neutralization with acid must be provided before the treated wastes are discharged. Miscellaneous process wastes are sometimes rerouted to pass through both stills and the dephenolizer.

The addition of a fixed ammonia still to the operation of a well designed and operated dephenolizer can produce effluents of sufficient quality to meet the proposed BPT limitations.

b. Several possible options exist at this point for those plants which do not have biological treatment systems. One potential route for plants discharging as point sources is toward adsorption of organics on activated carbon. Before this can be accomplished at a reasonable cost, certain preliminary steps must be carried out as follows:

(1) Flows must be minimized wherever possible. Barometric condensers on crystallizers should be recycled, with 4-6% blowdown to treatment. Final cooler recycle loops should be tightened, and miscellaneous wastewaters should be reduced to minimum flow through prevention of leaks, and spills.

(2) The wastewaters from the settling pond or sedimentation unit are filtered to remove the suspended solids and any tars or floating material which may remain, and are then passed through activated carbon columns. The resulting effluent is discharged. Filtration is accomplished most effectively by deep bed, mixed media pressure units, although other filtration alternatives are available.

c. An alternative preliminary treatment sequence prior to adsorption on carbon would provide aggressive oxidation using chemicals such as chlorine, chlorine dioxide, sodium hypochlorite, ozone, or peroxides to destroy organic pollutants, ammonia and cyanides. The acid addition in step 4(a) above would be relocated. A typical sequence using chlorine would include aeration; aggressive oxidation at high pH (alkaline chlorination); neutralization, using the relocated acid addition equipment from above; breakpoint chlorination; suspended solids removal by sedimentation or filtration; and a final polish by passing the wastewater through activated carbon columns.

d. Plants which discharge wastewaters to publicly-owned treatment works currently practice an intermediate level of treatment. For example, one such plant visited during this survey used aggressive oxidation with chlorine to provide batch treatment of excess ammonia liquor prior to discharge. Treatment is carried out only to the degree that the wastewater is acceptable to the regional sanitary authority. Most plants discharging to POTWs, including the one mentioned above, do not provide sufficient pretreatment to prevent discharge of pollutants which interfere with, pass through, or are otherwise incompatible with POTW operations.

5. Incineration/Evaporation Configuration

a. Another alternative approach to coke plant waste disposal is practiced at at least two plants, and was planned for a third plant. All of the wastewaters from the coke plant are distilled and incinerated in controlled combustion systems. Coke oven gas and crude coal tar are the only by-products recovered, and no wastewaters are discharged to receiving streams or to sanitary authorities. The system is viable only where the impact on air pollution can be tolerated, and therefore has very limited potential for widespread application.

b. Other plants achieve zero or near zero discharge of pollutants from by-product cokemaking operations by disposing of the process wastewaters in coke quenching. An adverse impact on air pollution occurs as a result so this alternative is expected to gradually decline as a solution to the problem of wastewater disposal. The nature and magnitude of pollutant emissions from quenching operations have been the subject of extensive study both here and abroad. Tests were conducted comparing emissions from plants using 100% fresh water make-up with those from plants with treated and/or untreated process wastewaters for make-up. At least one researcher conducted tests on the same quench stations using fresh and contaminated make-ups while maintaining other conditions as constant as possible. Researchers have concluded that typical "dirty water" quench stations release more than twice as much particulates; four times as much benzene-soluble organics; more than twice as much benzo(a)pyrene; and, nearly nine times as much benzene to the surrounding atmosphere than do the same operation using "clean water" for make-up.

c. Since by-product coke plants must continuously dispose of or otherwise eliminate water originally locked up as moisture in coals, the only likely approach to zero discharge from coke plants would be to require treatment of process wastewaters to an extent where their use for coke or slag quenching would not affect air quality. This level of treatment would approximate the more advanced stages of biological or physical/chemical systems described above as applicable to point source dischargers. The critical pollutant mitigating against the use of well-treated wastewaters for quenching is dissolved solids, since such solids become airborne particulate as the water evaporates. Since the capital and energy requirements for removing dissolved solids from coke plant wastewaters are high, most plants will have to attain a treated wastewater quality which is suitable for direct discharge to a receiving stream, or for indirect discharge through a POTW.

Control and Treatment Technologies for BAT, BCT, NSPS, PSES, and PSNS

Of the various control and treatment options available for treatment of by-product cokemaking wastewaters, the Agency has selected the following model treatment system to achieve the proposed limitations. The model system incorporates the following treatment steps.

The first step involves minimizing process wastewater flows. Barometric condenser or crystallizer wastewaters are recycled with a minor blowdown (4%) to treatment. Air pollution emission control scrubber loops are recycled at high rates. Blowdown from the preheating and charging are treated in the BPT system, while blowdowns from coke-side scrubbers are settled and then used to replace dilution waters at the biological treatment system.

For the BAT, BCT and PSES model treatment systems, a second or extended stage of biological treatment is added. For costing purposes separate aeration, sludge recycle components and clarifiers were considered. The vacuum filter originally installed to treat clarifier underflows at the BPT level of treatment is modified to handle the additional sludge from the BAT system. A final polishing from the second clarifier overflow is provided by filtration to control carryover of suspended matter and any toxic organics entrained in the suspended solids. This combination of treatment components provides more complete removal of toxic organic pollutants while also minimizing the discharge of particulates and toxic metal pollutants. One alternative to achieve further reduction of toxic organic pollutants involves the addition of powdered activated carbon to the activated sludge, thereby further enhancing organic and color removal. Using the biologically treated wastewater for coke quenching may achieve a "no discharge of process wastewater" condition, but is not universally applicable because of adverse impacts on air quality.

The NSPS and PSNS model treatment systems incorporate most of the BAT, BCT and PSES model treatment system components, although in somewhat different order. Flow minimization occurs earlier, since it can be incorporated into initial plant designs without regard for existing treatment components in place. Also, an advanced ammonia and cyanide stripping system is available which can provide somewhat lower levels in the wastewater sent to the biological systems. The addition of powdered activated carbon is a possible alternative for NSPS and PSNS. The disposal of treated wastewater by quenching is not considered to be appropriate for new sources for the reasons cited above.

Beehive cokemaking operators can achieve zero discharge as set out in the proposed BPT limitations by recycling all of the settling basin overflows back to quenching operations. This control and treatment technology is readily available to serve as a basis for BAT, BCT, or NSPS limitations for the beehive segment of the cokemaking subcategory. Since beehive cokemaking operations are located in areas remote from POTWs, and it is highly unlikely that new beehive operations will be built, the Agency is not proposing pretreatment standards for beehive cokemaking.

Plant Visits

Nine by-product coke plants and three beehive coke plants were visited during this study; four by-product and all beehive plants during the spring of 1973, and the remaining five by-product plants during 1977 and 1978. Table VII-1 provides a key to the symbols used in Tables VII-2, 3 and 4 and other tables to describe control and treatment technology. Tables VII-2 through VII-4 present raw and effluent gross waste concentrations and loads for each plant studied during the two surveys. A brief description of each wastewater treatment system follows. More details are available on the wastewater flow diagrams as indicated by a figure for each plant visited.

Plant A - Figure VII-1

Excess ammonia liquor, final cooler blowdown, and benzol plant wastes are subjected to free ammonia stripping, then to dephenolization by the solvent extraction technique. Dephenolized liquors are conveyed to a settling sump, then to the receiving stream. Barometric condenser water discharges direct to the receiving stream without treatment. Quench runoffs are recycled to extinction. Only fresh water is used for quench makeup.

Plant B - Figure VII-2

Excess ammonia liquor is collected and equalized (five day retention); diluted 3:1 with noncontact cooling water from light oil coolers; blended with phosphoric acid, antifoam and steam; treated in a single-stage aerated activated sludge lagoon (8 hour retention); clarified; and discharged to the receiving stream. The bulk of the sludge is recirculated, with minor blowdown of sludge to a sewage treatment plant. Final cooler blowdown and benzol plant wastewaters are diluted 1:2 and are disposed of by coke quenching. Quench waters are recycled to extinction. Coke wharf drainage is collected and impounded in a lagoon with no outlet.

Plant C - Figure VII-3

Excess ammonia liquor is dephenolized by light oil extraction; stripped of free and fixed ammonia; settled (two to three hour retention); and discharged to a POTW for further treatment. Final cooler blowdown and benzol plant wastewaters are used as makeup for coke quenching. Quench runoff and coke wharf drainage is recycled to extinction at quench stations. At least one quench station uses fresh water makeup only.

Plant D - Figure VII-4

Excess ammonia liquor is conveyed to a desulfurizer tower; filtered (ceramic media); dephenolized by solvent extraction; stripped of free and fixed ammonia; diluted (88:1) by a cooling water stream; and, discharged to the receiving stream. Quench stations use fresh water makeup only, with no discharge.

Plant 001 - Figure VII-5

Excess ammonia liquor is equalized; stripped of free ammonia; dephenolized by vapor recirculation; diluted (85:1) with cooling water and other wastewater flows; and discharged to a receiving stream. Final cooler blowdown is diluted at 2:1 and disposed of by coke quenching. Quench runoff recycles to extinction. The installation of adsorption by activated carbon following chlorination was under construction at the time of the survey.

Plant 002 - Figure VII-6

Excess ammonia liquor and final cooler blowdown is dephenolized by extraction with light oils; chlorinated on a batch basis under alkaline conditions; settled; and, discharged to a POTW. Blowdowns from a quenching car scrubber system and fresh water are used as makeup for coke quenching, which is recycled to extinction.

Plant 003 - Figure VII-7

Excess ammonia liquor and miscellaneous wastewaters are equalized; diluted; stripped of ammonia and cyanides by an advanced free and fixed still system; treated in two step (or extended) bio-oxidation lagoons with aeration, clarification, secondary settling, oil skimming; and, discharged to terminal treatment lagoon with other steel plant wastewaters. The final effluent is discharged to a receiving stream. Final cooler wastewaters are recirculated with no blowdown; noncontact cooling water is recycled over cooling towers and used as the sole makeup to all quenching operations. Excess quench water is recycled to extinction.

Plant 008 - Figure VII-8

Excess ammonia liquor is routed through free and fixed ammonia stills; blended with benzol plant wastewaters; equalized; cooled; treated in parallel (only one stage operating during survey) bio-oxidation reactors; flocculated with alum and polymer; settled; and, discharged to a receiving stream. Quenching stations use only fresh water for makeup and have no discharge.

Plant 009 - Figure VII-9 (Physical/chemical system)

Excess ammonia liquor from three coke plants (one off-site) is mixed; passed through a gas flotation unit (with a side stream through dephenolization); mixed media filtration; adsorption on activated carbon; and, free and fixed ammonia stripping. Benzol plant wastewaters from two plants are mixed; passed through gas flotation;

mixed media filtration; and, adsorption by activated carbon prior to disposal in coke quenching.

Plant E Figure VII-10

Coke quench runoffs are treated "once-through" in simple settling ponds, with no provision for recycle.

Plant F - Figure VII-11

Coke quench runoffs are collected in a settling basin. The overflows are recirculated to quench stations with no aqueous discharge from the plant.

Plant G - Figure VII-12

Coke quench runoffs are collected in primary settling ponds, further clarfied in secondary settling ponds, and are recycled to quench stations. There is no wastewater discharge from this plant.

Summary of Analytical Data

A review of data on Tables VII-2 through VII-4 shows that certain bio-oxidation and carbon adsorption systems are effective in reducing toxic organic pollutants to low levels from by-product cokemaking operations, and that the total recycle of wastewater in beehive cokemaking operations effectively controls discharges from these plants.

Biological systems have been used for treating cokemaking wastewaters for a number of years, with the removal of phenolic compounds as a primary goal. Although a great deal of information is available on the performance of activated sludge units in controlling phenolic compounds, the development of data regarding toxic pollutants other than phenolic compounds and cyanides has only recently been undertaken. Even less operating data for toxic organic pollutants are available from full scale activated carbon adsorption treatment plants since, thus far, only two companies have installed and operated such technology. EPA sampling surveys demonstrated that either technique can eliminate more than 90% of all toxic organic pollutants present in coke plant wastewaters, although the biological systems have certain operating cost advantages.

Originally, advanced levels of treatment using biological systems were expected to involve multiple stages for accomplishing selective degradation of pollutants in series, e.g., ammonia and cyanide removal, nitrification and denitrification. The two bio-plants surveyed for toxic pollutant removals (Plants 003 and 008) were effectively controlling toxic pollutants using a single stage (008) or two identical stages in series (003). Plant 008 has begun using its second stage since it was originally surveyed. Overall removal of toxic organic pollutants averaged better than 90% with phenolic compounds, naphthalenes, benzo(a)pyrenes, acenaphthylenes and xylenes being reduced at a rate greater than 99%. Chloroform appeared to be the major organic toxic pollutant which persists in the final effluents, at concentrations of 0.2 mg/l. Measurable amounts of benzene and toluene also remain, even though the systems have removal efficiencies of 96.7% or better. Excessive concentrations of these two pollutants were originally present in raw wastewater, thus even very effective removal efficiencies still leave behind measurable residues. Despite the continued presence of fractions of a milligram per liter for a limited number of organic pollutants, activated sludge systems proved to be very effective in controlling toxic organic effluents from coke plants.

Data for one of the full-scale carbon adsorption systems is presented wherever Plant 009 is discussed. These data demonstrate uniformly good removal efficiencies for most of the toxic organics. Exceptions include chloroform (which proved to be refractory to biological treatment also), and acrylonitrile, which was reduced by 74.3% but still appeared at a concentration of 0.19 mg/l in the effluent. Poor removal efficiencies for ethylbenzene and parachlorometacresol are primarily due to their extremely low concentrations in untreated wastewater, <0.002 and 0.007 mg/l respectively. In general, field sampling at Plant 009 demonstrates the effectiveness of activated carbon adsorption for treating toxic organic pollutants.

Comparison of Data

As mentioned above, the availability of long-term data for many of the toxic pollutants is limited. However, considerable data are available for pollutants such as phenolic compounds (4-AAP), cyanides, ammonia-N, oil and grease, and suspended solids. Table VII-5 compares the long-term data for those pollutants, as reported by two plants, with short-term results observed during EPA sampling surveys at the same sampling point. Note that short-term data are within one standard deviation of the long-term mean at both plants for most of the pollutants measured when long-term means are based on 50 or more observations. The only occurrences where short-term values are more than two standard deviations from the long-term mean are for copper and lead analyses for Plant 009, and in these instances the "long-term" mean is based on only six observations. The more critical toxic pollutants, cyanide, and phenolic compounds, were all measured during EPA surveys at levels within one standard deviation above or below the long-term mean for those pollutants.

TABLE VII-1

OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

Symbols

A. Operating Modes

1. OT Once-Through

2. Rt,s,n Recycle, where t = type waste
s = stream recycled
n = % recycled

t: U = Untreated
T = Treated

	s	n
P	Process Wastewater	% of raw waste flow
F	Flume Only	% of raw waste flow
S	Flume and Sprays	% of raw waste flow
FC	Final Cooler	% of FC flow
BC	Barometric Cond.	% of BC flow
VS	Abs. Vent Scrub.	% of VS flow
FH	Fume Hood Scrub.	% of FH flow

3. REt,n Reuse, where t = type
n = % of raw waste flow

t: U = before treatment
T = after treatment

4. BDn Blowdown, where n = discharge as % of raw waste flow

B. Control Technology

10. DI Deionization

11. SR Spray/Fog Rinse

12. CC Countercurrent Rinse

13. DR Drag-out Recovery

C. Disposal Methods

20. H Haul Off-Site

21. DW Deep Well Injection

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 2

C. Disposal Methods (cont.)

22.	Qt,d	Coke Quenching, where t = type d = discharge as % of makeup t: DW = Dirty Water CW = Clean Water
23.	EME	Evaporation, Multiple Effect
24.	ES	Evaporation on Slag
25.	EVC	Evaporation, Vapor Compression Distillation

D. Treatment Technology

30.	SC	Segregated Collection
31.	E	Equalization/Blending
32.	Scr	Screening
33.	OB	Oil Collecting Baffle
34.	SS	Surface Skimming (oil, etc.)
35.	PSP	Primary Scale Pit
36.	SSP	Secondary Scale Pit
37.	EB	Emulsion Breaking
38.	A	Acidification
39.	AO	Air Oxidation
40.	GF	Gas Flotation
41.	M	Mixing
42.	Nt	Neutralization, where t = type t: L = Lime C = Caustic A = Acid W = Wastes O = Other, footnote

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 3

D. Treatment Technology (cont.)

43.	FLt	Flocculation, where t = type t: L = Lime A = Alum P = Polymer M = Magnetic O = Other, footnote
44.	CY	Cyclone/Centrifuge/Classifier
44a.	DT	Drag Tank
45.	CL	Clarifier
46.	T	Thickener
47.	TP	Tube/Plate Settler
48.	SLn	Settling Lagoon, where n = days of retention time
49.	BL	Bottom Liner
50.	VF	Vacuum Filtration (of e.g., CL, T, or TP underflows)
51.	Ft,m,h	Filtration, where t = type m = media h = head

t	m	h
D = Deep Bed	S = Sand	G = Gravity
F = Flat Bed	O = Other, footnote	P = Pressure

52.	CLt	Chlorination, where t = type t: A = Alkaline B = Breakpoint
53.	CO	Chemical Oxidation (other than CLA or CLB)

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 4

D. Treatment Technology (cont.)

54.	BOt	Biological Oxidation, where t = type t: An = Activated Sludge n = No. of Stages T = Trickling Filter B = Biodisc O = Other, footnote
55.	CR	Chemical Reduction (e.g., chromium)
56.	DP	Dephenolizer
57.	ASt	Ammonia Stripping, where t = type t: F = Free L = Lime C = Caustic
58.	APt	Ammonia Product, where t = type t: S = Sulfate N = Nitric Acid A = Anhydrous P = Phosphate H = Hydroxide O = Other, footnote
59.	DSt	Desulfurization, where t = type t: Q = Qualifying N = Nonqualifying
60.	CT	Cooling Tower
61.	AR	Acid Regeneration
62.	AU	Acid Recovery and Reuse
63.	ACt	Activated Carbon, where t = type t: P = Powdered G = Granular
64.	IX	Ion Exchange
65.	RO	Reverse Osmosis
66.	D	Distillation

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 5

D. Treatment Technology (cont.)

67.	AA1	Activated Alumina
68.	OZ	Ozonation
69.	UV	Ultraviolet Radiation
70.	CNTt,n	Central Treatment, where t = type n = process flow as % of total flow t: 1 = Same Subcats. 2 = Similar Subcats. 3 = Synergistic Subcats. 4 = Cooling Water 5 = Incompatible Subcats.
71.	On	Other, where n = Footnote number
72.	SB	Settling Basin
73.	AE	Aeration
74.	PS	Precipitation with Sulfide

TABLE VII-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS

Raw Wastewaters

	Reference Code	0432B		0112		0384A		0272		Average of 4	
	Plant Code	A		B		C		D			
	Sample Point(s)	4+5(1)		1+4(1)		1+3(1)		1		-	
	Flow (Gal/Ton)	139		127		134		21.6		105	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	24	0.0139	36	0.0191	129	0.0721	30	0.00270	55	0.0270
	Oil & Grease	21	0.0122	240	0.127	93	0.0520	147	0.0132	125	0.0511
	Ammonia-N	1564	0.907	1137	0.602	1729	0.966	3715	0.335	2036	0.703
	Sulfides	8.9	0.00516	629	0.333	152	0.0849	183	0.0165	243	0.110
	Thiocyanates	112	0.0649	233	0.123	28.4	0.0159	128	0.0115	125	0.0538
	pH (Units)	9.4	-	8.3	-	8.1	-	8.7	-	8.1-9.4	
117	Beryllium	<0.02	<0.000012	<0.02	<0.000011	<0.04	<0.000022	<0.02	<0.00002	<0.025	<0.000012
121	Cyanides	101	0.0585	114	0.0604	61.8	0.0345	145	0.0131	105	0.0416
123	Mercury	0.004	0.000002	0.0009	*	0.0007	*	0.0008	*	0.0016	0.000001
191	Phenolic Cpds.	448	0.260	354	0.187	358	0.200	708	0.0638	467	0.178

Treated Effluents

	Sample Point(s)	2+4(1)		2		2(2)		2	
	Flow (Gal/Ton)	156		108		40.6		28.8	
	C&TT	ASF,DP,SB		E,BOA-1,QD		DP,ASL,QD		DSN,DP,ASL	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	5	0.00325	163(3)	0.0734	102	0.0173	537(3)	0.0645
	Oil & Grease	3.4	0.00221	2.5	0.00113	19	0.00322	12.4	0.00149
	Ammonia-N	797	0.518	957	0.431	388	0.0657	114	0.0137
	Sulfides	0.71	0.000462	0.26	0.000117	113	0.0191	91	0.0109
	Thiocyanates	29	0.0189	12.5	0.00563	64	0.0108	88	0.0106
	pH (Units)	8.6	-	7.5	-	9.5-11.8		11.7	-
117	Beryllium	<0.02	<0.000013	<0.02	<0.000009	<0.04	<0.000007	<0.02	<0.000002
121	Cyanides	95	0.0618	3.77	0.00170	68	0.0115	124	0.0149
123	Mercury	0.0005	*	0.0012	*	<0.0008	*	<0.0008	*
191	Phenolic Cpds.	1.32	0.000859	0.064	0.000029	219	0.0371	5.13	0.000616

NA: Not analyzed
* : <0.000001 lb/1000 lb

(1) The mg/l values represent concentrations which would be present in the combined wastewaters.
(2) Plant discharges to a POTW.
(3) No sedimentation provided.

NOTE: For definition of C&TT Codes see Table VII-1

TABLE VII-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS

Raw Wastewaters:

	Reference Code	0732A		0464C		0868A		0920F		0684F		Average of 4$^{(2)}$	
	Plant Code	001		002		003		008		009			
	Sample Point(s)	C+D$^{(1)}$		B		C		B+(D-C)$^{(1)}$		B+C$^{(1)}$		-	
	Flow (Gal/Ton)	5142$^{(2)}$		35.9		27.8		55.8		96.7		54.1	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	177	3.80	14	0.00210	80	0.00927	61	0.0142	86	0.0347	60	0.0151
	Oil & Grease	27	0.579	82	0.0123	184	0.0213	113	0.0263	126	0.0508	126	0.0277
	Ammonia-N	111	2.38	5067	0.759	2387	0.277	2696	0.627	4109	1.66	3565	0.831
	Phenolic Cpds.	9.08	0.195	702	0.105	626	0.0726	734	0.171	1067	0.430	782	0.195
	Sulfides	2.8	0.0600	1833	0.274	439	0.0509	528	0.123	515	0.208	829	0.164
	Thiocyanates	26	0.557	1245	0.186	592	0.0686	383	0.0891	453	0.183	668	0.132
	pH (Units)	6.9-7.9		9.0-9.1		9.6-9.8		8.8-11.7		8.4-8.6		6.9-11.7	
3	Acrylonitrile	0.021	0.000450	4.67	0.000700	ND	ND	2.81	0.000654	.745	0.000300	2.06	0.000414
4	Benzene	13.2	0.283	2.83	0.000424	27.2	0.00315	34.2	0.00796	45.6	0.0184	27.5	0.00748
21	2,4,6-Trichlorophenol	ND	ND	0.400	0.000060	ND	ND	ND	ND	ND	ND	0.100	0.000015
22	Parachloronitrolcresol	ND	ND	4.33	0.000648	ND	ND	ND	ND	0.007	0.000003	1.08	0.000163
23	Chloroform	ND	ND	<0.003	*	1.37	0.000159	0.275	0.000064	0.0321	0.000013	0.420	0.000059
34	2,4-Dimethylphenol	ND	ND	83.7	0.0125	5.33	0.000618	2.34	0.000544	ND	ND	22.8	0.00342
35	2,4-Dinitrotoluene	0.529	0.0113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36	2,6-Dinitrotoluene	0.138	0.00296	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38	Ethylbenzene	ND	ND	0.297	0.000044	0.640	0.000074	0.336	0.000078	<0.003	*	0.319	0.000049
39	Fluoranthene	0.018	0.000386	0.977	0.000146	3.13	0.000363	0.975	0.000227	0.588	0.000237	1.42	0.000243
54	Isophorone	0.055	0.00118	ND	ND	ND	ND	<0.002	*	ND	ND	<0.001	*
55	Naphthalene	1.92	0.0412	10.6	0.00159	28.9	0.00335	22.7	0.00528	27.5	0.0111	22.4	0.00533
60	4,6-Dinitro-o-cresol	ND	ND	0.967	0.000145	ND	ND	ND	ND	0.0440	0.000018	0.253	0.000041
64	Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0.788	0.000318	0.197	0.000080
65	Phenol	3.09	0.0663	666	0.0997	327	0.0379	240	0.0558	78.9	0.0318	328	0.0563
(3)	Phthalates, Total	1.06	0.0227	1.98	0.000296	2.30	0.000267	1.05	0.000244	6.80	0.00274	3.03	0.000887
72	Benzo(a)anthracene	0.002	0.000043	<0.007	*	ND	ND	0.008	0.000002	0.617	0.000249	0.158	0.000063
73	Benzo(a)pyrene	0.001	0.000021	0.513	0.000077	ND	ND	0.115	0.000027	0.109	0.000044	0.184	0.000037
76	Chrysene	0.001	0.000021	0.287	0.000043	ND	ND	0.124	0.000029	0.805	0.000325	0.304	0.000099
77	Acenaphthylene	0.017	0.000365	3.20	0.000479	6.37	0.000738	2.78	0.000647	2.66	0.00107	3.75	0.000734
80	Fluorene	0.029	0.000622	0.770	0.000115	2.47	0.000286	0.488	0.000114	0.267	0.000108	1.00	0.000156
84	Pyrene	0.004	0.000086	0.817	0.000122	2.63	0.000305	0.414	0.000096	0.617	0.000249	1.12	0.000193
86	Toluene	1.88	0.0403	0.910	0.000136	8.92	0.00103	5.45	0.00127	6.13	0.00247	5.35	0.00123
130	Xylene	ND	ND	<0.010	<0.000002	<0.01	*	ND	ND	101	0.0407	25.3	0.0102
114	Antimony	<0.004	<0.00009	0.033	0.000005	NA	NA	0.138	0.000032	0.246	0.000099	0.139	0.000045
115	Arsenic	0.005	0.000107	0.267	0.000040	NA	NA	0.382	0.000089	0.133	0.000054	0.261	0.000061
121	Cyanides	3.29	0.0705	21.5	0.00322	22.3	0.00259	16.6	0.00386	28.5	0.0115	22.2	0.00529
125	Selenium	<0.003	<0.00006	0.457	0.000068	NA	NA	1.03	0.000240	0.066	0.000027	0.518	0.000112
126	Silver	<0.025	<0.00054	<0.025	<0.000004	<0.001	*	0.074	0.000017	<0.020	<0.000008	<0.03	0.000008
128	Zinc	0.218	0.00467	0.241	0.000036	0.130	0.000015	0.271	0.000063	<0.100	<0.00004	0.185	0.000039

TABLE VII-3
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
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Treated Effluents

	Reference Code	0732A		0464C		0868A		0920F		0684F	
	Plant Code	001		002		003		008		009 (1)(4)	
	Sample Point(s)	D		D		E		E		F+J	
	Flow (Gal/Ton)	5072		35.9 (5)		201		139		96.7	
	C&TT	ASF,DF		DF,CLA		ASC,BOA2,CL,SB,SS		ASL,E,CT,BOA1,CL		DF,GF,FDSP,ACG,ASF	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	179	3.79	6	0.000898	39	0.0327	43	0.0249	30	0.0121
	Oil & Grease	27	0.571	40	0.00599	4	0.00335	8	0.00464	9	0.00363
	Ammonia-N	112	2.37	4875	0.730	0.77	0.000645	127	0.0736	213	0.0859
	Phenolic Cpds.	7.8	0.165	84.1	0.0126	0.028	0.000023	0.056	0.000033	0.755	0.000304
	Sulfides	3	0.0634	1730	0.259	<0.3	<0.00025	0.21	0.000122	527	0.213
	Thiocyanates	26	0.550	1048	0.157	<0.9	<0.00075	0.84	0.000487	397	0.160
	pH (Units)	6.9-7.9		8.9-9.0		7.4-7.5		7.5-7.8		8.8-9.9	
3	Acrylonitrile	ND	ND	3.00	0.000449	ND	ND	ND	ND	0.190	0.000077
4	Benzene	12.8	0.271	120	0.0180	<0.060	<0.00005	<0.257	<0.00015	<0.010	<0.000004
21	2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22	Parachlorometacresol	ND	ND	ND	ND	0.064	0.000054	ND	ND	<0.003	*
23	Chloroform	ND	ND	ND	ND	<0.281	<0.00024	0.203	0.000118	0.045	0.000018
34	2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	2,4-Dinitrotoluene	0.510	0.0108	ND	ND	ND	ND	ND	ND	ND	ND
36	2,6-Dinitrotoluene	0.137	0.00290	ND	ND	ND	ND	ND	ND	ND	ND
38	Ethylbenzene	ND	ND	4.40	0.000659	0.039	0.000033	0.014	0.000008	<0.007	<0.000003
39	Fluoranthene	0.003	0.000063	0.503	0.000075	0.008	0.000007	<0.003	<0.000002	<0.007	<0.000003
54	Isophorone	ND	ND	0.167	0.000025	ND	ND	ND	ND	ND	ND
55	Naphthalene	1.40	0.0296	5.87	0.000879	ND	ND	<0.003	<0.000002	<0.005	<0.000002
60	4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND	<0.005	<0.000002
64	Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0.025	0.000010
65	Phenol	2.30	0.0486	52.8	0.00790	<0.015	<0.000012	0.040	0.000023	0.048	0.000019
(3)	Phthalates, Total	0.689	0.0146	1.87	0.000280	0.192	0.000161	3.54	0.00205	0.188	0.000076
72	Benzo(a)anthracene	ND	ND	ND	ND	<0.002	<0.000002	0.027	0.000016	<0.005	<0.000002
73	Benzo(a)pyrene	ND	ND	0.013	0.000002	0.013	0.000011	ND	ND	<0.002	*
76	Chrysene	ND	ND	0.095	0.000014	<0.006	<0.000005	0.010	0.000006	<0.005	<0.000002
77	Acenaphthylene	0.013	0.000275	1.60	0.000240	<0.007	<0.000006	<0.003	<0.000002	<0.005	<0.000002
80	Fluorene	0.027	0.000571	0.190	0.000028	<0.010	<0.000008	<0.003	<0.000002	<0.005	<0.000002
84	Pyrene	0.003	0.000063	0.277	0.000042	0.026	0.000022	0.007	0.000004	<0.007	<0.000003
86	Toluene	1.67	0.0353	10.5	0.00157	0.040	0.000034	0.073	0.000042	<0.007	<0.000003
130	Xylene	ND	ND	25.4	0.00380	ND	ND	ND	ND	<0.005	<0.000002
114	Antimony	<0.004	<0.00008	0.041	0.000006	NA	NA	0.133	0.000077	<0.22	<0.00009
115	Arsenic	0.005	0.000106	0.140	0.000021	NA	NA	0.403	0.000234	0.149	<0.00006
121	Cyanides	0.72	0.0152	16.2	0.00243	2.34	0.00196	2.45	0.00142	22.5	0.00907
125	Selenium	<0.003	<0.00006	0.633	0.000095	NA	NA	0.650	0.000377	0.034	0.000014
126	Silver	<0.025	<0.0005	<0.025	<0.000004	<0.002	<0.000002	<0.010	<0.000006	<0.020	<0.000008
128	Zinc	0.220	0.00465	0.126	0.000019	<0.060	<0.00005	0.087	0.000050	<0.005	<0.000002

TABLE VII-3
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
PAGE 3

FOOTNOTES:

ND: None detected.
NA: Not analyzed.
* : <0.000001 lb/1000 lb.

(1) The mg/l values represent concentrations which would be present in the combined wastewaters.
(2) Average does not include samples from plant 001 because of the presence of over 5000 GPT non-contact cooling water in mixed samples.
(3) Values shown are the sum of all mg/l in lb/1000 lb for the following phthalates: 66 Bis-(2-ethylhexyl); 67 Butylbenzyl; 68 Di-n-butyl; 69 Di-n-octyl; 70 Diethyl and 71 Dimethyl phthalate.
(4) Effluent is the sum of direct discharge F and treated wastewater J which is disposed of by quenching.
(5) Plant discharges to POTW for further treatment.

NOTE: For definition of C&TT Codes, see Table VII-1.

TABLE VII-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BEEHIVE COKEMAKING OPERATIONS

Raw Wastewaters

	Plant Code	E		F		G		Average of 3	
	Sample Point(s)	3		1		1		-	
	Flow (Gal/Ton)	490		490		123		368	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	165	0.337	65	0.133	937	0.481	389	0.317
	Oils and Greases	0.8	0.00163	0.9	0.00184	8.2	0.00421	3.3	0.00256
	Ammonia-N	0.33	0.000674	0.37	0.000756	0.43	0.000221	0.38	0.000550
	Sulfide	<0.02	<0.00004	<0.02	<0.00004	0.18	0.000092	0.07	0.000057
	Thiocyanate	<3	<0.006	<3	<0.006	7	0.00359	4	0.00520
	pH (Units)	7.3		7.3		7.0-7.3		7.0-7.3	
117	Beryllium	<0.02	<0.00004	<0.02	<0.00004	<0.02	<0.00001	<0.02	<0.00003
121	Cyanides	0.005	0.000010	0.035	0.000072	2.27	0.00116	0.77	0.000414
123	Mercury	0.0044	0.000009	0.0016	0.000003	0.0044	0.000002	0.0035	0.000005
191	Phenolic Cpds.	0.016	0.000033	0.073	0.000149	22.6	0.0116	7.56	0.00393

Treated Effluents

	Sample Point(s)	4		2		2	
	Flow (Gal/Ton)	490		0		0	
	C&TT	SB		SB,RTP100		PSP,SB,RTP100	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	36	0.0736	36	0	210	0
	Oils & Greases	0.2	0.000410	0.8	0	3.9	0
	Ammonia-N	0.20	0.000410	0.67	0	0.44	0
	Sulfide	<0.02	<0.00004	<0.02	0	0.14	0
	Thiocyanate	<3	<0.006	<3	0	12	0
	pH (Units)	7.1		7.3		6.8-7.1	
117	Beryllium	<0.02	<0.00004	<0.02	0	<0.02	0
121	Cyanides	0.004	0.000008	0.049	0	2.62	0
123	Mercury	0.002	0.000004	0.0028	0	0.0018	0
191	Phenolic Cpds.	0.014	0.000029	0.132	0	24.2	0

NOTE: For definition of C&TT Codes, see Table VII-1.

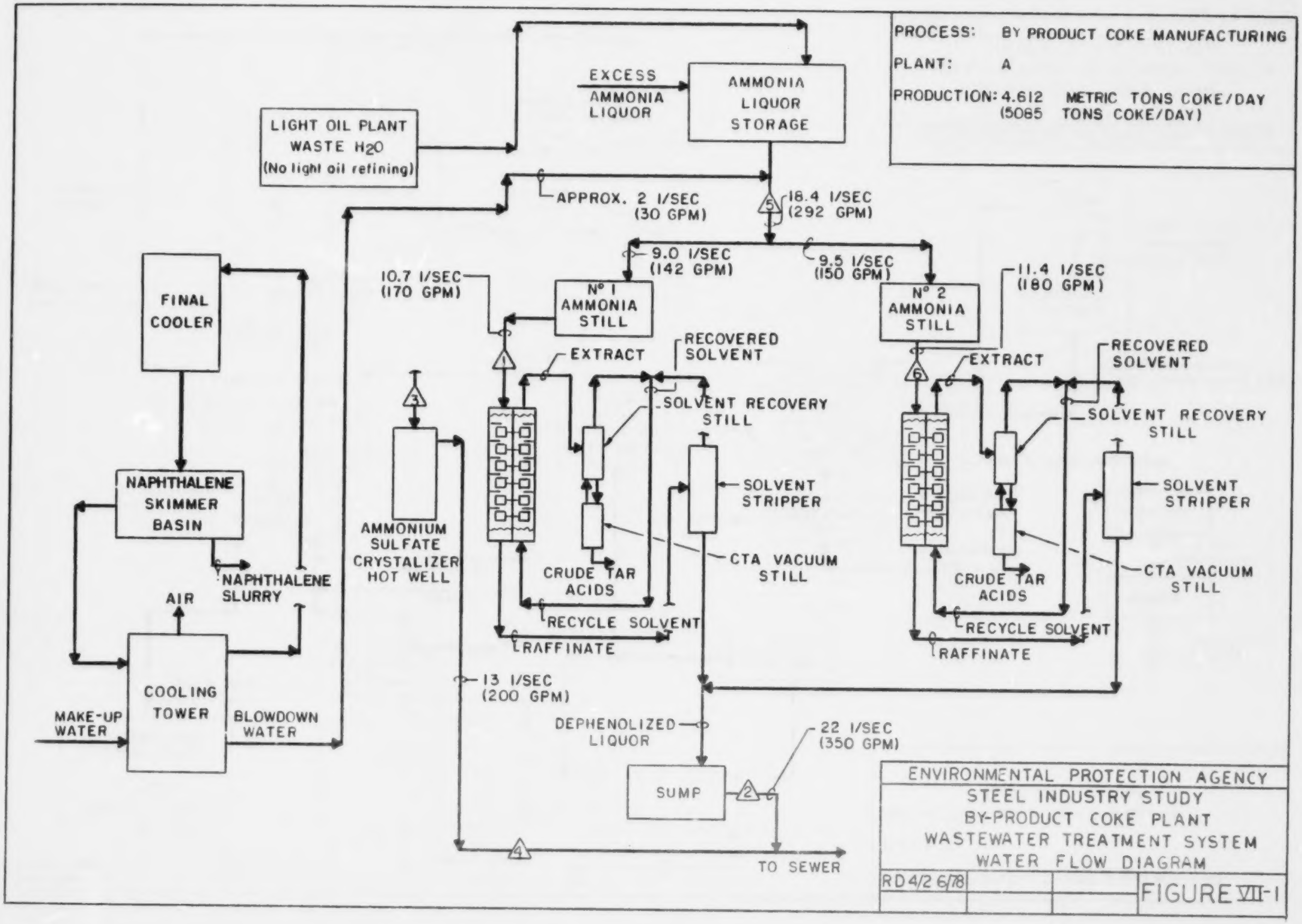
TABLE VII-5

DATA COMPARISON - PLANT LONG-TERM VS. SAMPLING VISIT
BY-PRODUCT COKEMAKING

Plant, Location & Parameter	Sample Data Base		Concentrations(1)				EPA Samples(2)		Within(3) 1 Std. Dev.	Within(4) Range
	Frequency	Number	Max.	Min.	Mean	Standard Deviation	Number	Mean		
003: (0868A) 21 Months of Data										
Biotreatment Plant Clarifier Overflow:										
Phenolic Cpds., mg/l	Weekly	88	0.72	<0.01	0.034	0.076	3	0.028	X	X
Ammonia-N, mg/l	Weekly	87	233	0.1	21.5	44.7	3	0.77	X	X
Cyanides, mg/l	Weekly	86	7.64	0.05	1.47	1.21	3	2.34	X	X
pH (Units)	Weekly	86	8.5	6.1	7.4	0.4	3	7.4-7.5	X	X
Settling Basin Effluent (including untreated side streams):										
Phenolic Cpds., mg/l	Weekly	90	5.46	0.015	0.246	0.689	3	0.058	X	X
Ammonia-N, mg/l	Weekly	90	71.4	4.10	17.0	12.6	3	3.33	-1.08	Below
Cyanides, mg/l	Weekly	90	5.03	0.036	0.664	0.573	3	0.511	X	X
pH (Units)	Weekly	90	10.7	6.6	7.8	0.6	3	7.2-7.4	X	X
Oils & Greases, mg/l	Weekly	90	17.7	1.0	4.9	3.8	2	4	X	X
009: (0684F) 5 to 12 Months of Data										
Treated Effluent to River:										
Phenolic Cpds., mg/l	Weekly	50	2.88	<0.01	0.185	0.505	1	0.217	X	X
Ammonia-N, mg/l	Weekly	51	8450	9.9	544	1270	2	290	X	X
Cyanides, mg/l	Weekly	51	250	0.28	23.8	36.2	2	12.8	X	X
pH, (Units)	Weekly	43	13.6	7.6	10.7	1.7	2	8.8-9.0	X	X
Oils & Grease, mg/l	Weekly	50	23	2	5.6	3.7	2	10	+1.19	X
Suspended Solids, mg/l	Weekly	50	224	6	41.8	39.9	2	59	X	X
Dissolved Solids, mg/l	Weekly	50	30,124	1,406	14,677	5,996	2	15,875	X	X
Temperature, °F	Weekly	21	198	164	185	8.4	2	198	+1.55	X
Cadmium, gm/l	Monthly	5	0.059	0.004	0.031	0.020	2	0.04	X	X
Copper, mg/l	Monthly	6	0.101	0.056	0.078	0.017	2	0.03	-2.82	Below
Lead, mg/l	Monthly	6	0.134	0.082	0.110	0.020	2	0.19	+4.00	Above

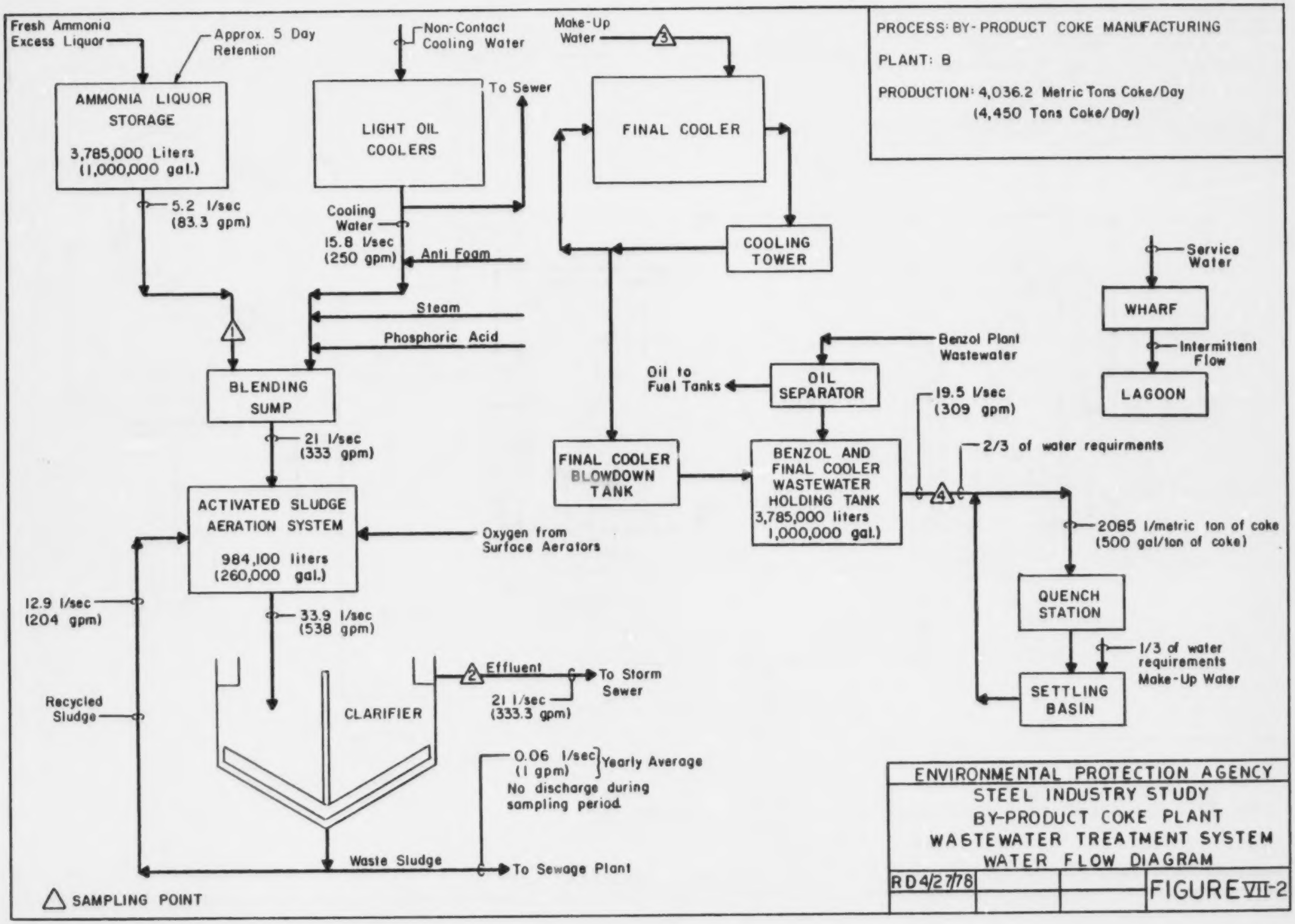
---

(1) Data were reported in plant responses to D-DCP questionnaires.
(2) Data were collected during 2 or 3 days of sampling at each plant.
(3) X indicates EPA value is within one standard deviation of plant's long-term mean value. A number in this column indicates that the EPA value is that many standard deviations above or below the plant's long-term mean value. Plus means above, and minus, below.
(4) X indicates EPA value is within the long-term maximum and minimum values stated by the plant. If the EPA value is outside that range, the word "above" or "below" indicates direction.


LIGHT OIL PLANT WASTE H_2O (No light oil refining)
EXCESS AMMONIA LIQUOR
AMMONIA LIQUOR STORAGE
APPROX. 2 l/SEC (30 GPM)
5
18.4 l/SEC (292 GPM)
9.0 l/SEC (142 GPM)
9.5 l/SEC (150 GPM)
FINAL COOLER
10.7 l/SEC (170 GPM)
N° 1 AMMONIA STILL
N° 2 AMMONIA STILL
11.4 l/SEC (180 GPM)
1
6
EXTRACT
RECOVERED SOLVENT
EXTRACT
RECOVERED SOLVENT
3
SOLVENT RECOVERY STILL
SOLVENT RECOVERY STILL
NAPHTHALENE SKIMMER BASIN
SOLVENT STRIPPER
SOLVENT STRIPPER
AMMONIUM SULFATE CRYSTALIZER HOT WELL
CRUDE TAR ACIDS
CTA VACUUM STILL
CRUDE TAR ACIDS
CTA VACUUM STILL
NAPHTHALENE SLURRY
AIR
RECYCLE SOLVENT
RECYCLE SOLVENT
RAFFINATE
RAFFINATE
13 l/SEC (200 GPM)
COOLING TOWER
MAKE-UP WATER
BLOWDOWN WATER
DEPHENOLIZED LIQUOR
22 l/SEC (350 GPM)
SUMP
2
4
TO SEWER

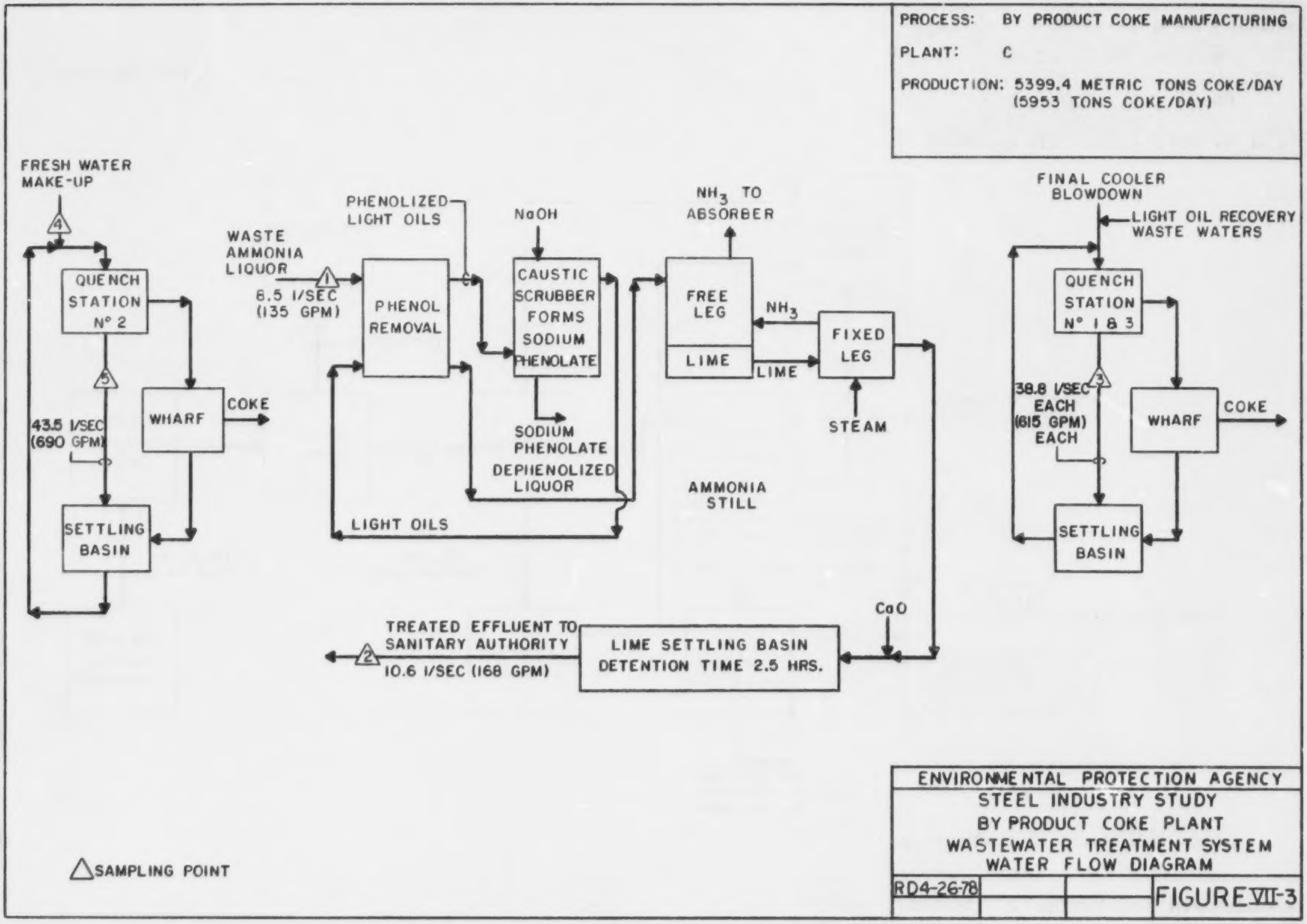
PROCESS: BY PRODUCT COKE MANUFACTURING
PLANT: A
PRODUCTION: 4.612 METRIC TONS COKE/DAY
(5065 TONS COKE/DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD 4/2 6/78
FIGURE VIII-1


PROCESS: BY-PRODUCT COKE MANUFACTURING
PLANT: B
PRODUCTION: 4,036.2 Metric Tons Coke/Day
(4,450 Tons Coke/Day)
Fresh Ammonia Excess Liquor
Approx. 5 Day Retention
AMMONIA LIQUOR STORAGE
3,785,000 Liters (1,000,000 gal.)
5.2 l/sec (83.3 gpm)
Non-Contact Cooling Water
LIGHT OIL COOLERS
To Sewer
Cooling Water
15.8 l/sec (250 gpm)
Anti Foam
Steam
Phosphoric Acid
1
BLENDING SUMP
21 l/sec (333 gpm)
ACTIVATED SLUDGE AERATION SYSTEM
984,100 liters (260,000 gal.)
Oxygen from Surface Aerators
12.9 l/sec (204 gpm)
33.9 l/sec (538 gpm)
Recycled Sludge
CLARIFIER
2
Effluent
To Storm Sewer
21 l/sec (333.3 gpm)
0.06 l/sec (1 gpm) Yearly Average
No discharge during sampling period
Waste Sludge
To Sewage Plant
SAMPLING POINT
Make-Up Water
3
FINAL COOLER
COOLING TOWER
FINAL COOLER BLOWDOWN TANK
Oil to Fuel Tanks
OIL SEPARATOR
Benzol Plant Wastewater
BENZOL AND FINAL COOLER WASTEWATER HOLDING TANK
3,785,000 liters 1,000,000 gal.)
19.5 l/sec (309 gpm)
4
2/3 of water requirments
2085 l/metric ton of coke (500 gal/ton of coke)
QUENCH STATION
1/3 of water requirements Make-Up Water
SETTLING BASIN
Service Water
WHARF
Intermittent Flow
LAGOON
RD 4/27/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-2


FRESH WATER MAKE-UP
4
QUENCH STATION N° 2
5
43.5 l/SEC (690 GPM)
WHARF
COKE
SETTLING BASIN
WASTE AMMONIA LIQUOR
1
6.5 l/SEC (135 GPM)
PHENOL REMOVAL
PHENOLIZED LIGHT OILS
LIGHT OILS
NaOH
CAUSTIC SCRUBBER FORMS SODIUM PHENOLATE
SODIUM PHENOLATE
DEPHENOLIZED LIQUOR
NH3 TO ABSORBER
FREE LEG
LIME
NH3
LIME
FIXED LEG
STEAM
AMMONIA STILL
CaO
LIME SETTLING BASIN DETENTION TIME 2.5 HRS.
TREATED EFFLUENT TO SANITARY AUTHORITY
2
10.6 l/SEC (168 GPM)
FINAL COOLER BLOWDOWN
LIGHT OIL RECOVERY WASTE WATERS
QUENCH STATION N° 1 & 3
3
38.8 l/SEC EACH (615 GPM) EACH
WHARF
COKE
SETTLING BASIN
△SAMPLING POINT
RD4-26-78

PROCESS: BY PRODUCT COKE MANUFACTURING

PLANT: C

PRODUCTION: 5399.4 METRIC TONS COKE/DAY
(5953 TONS COKE/DAY)

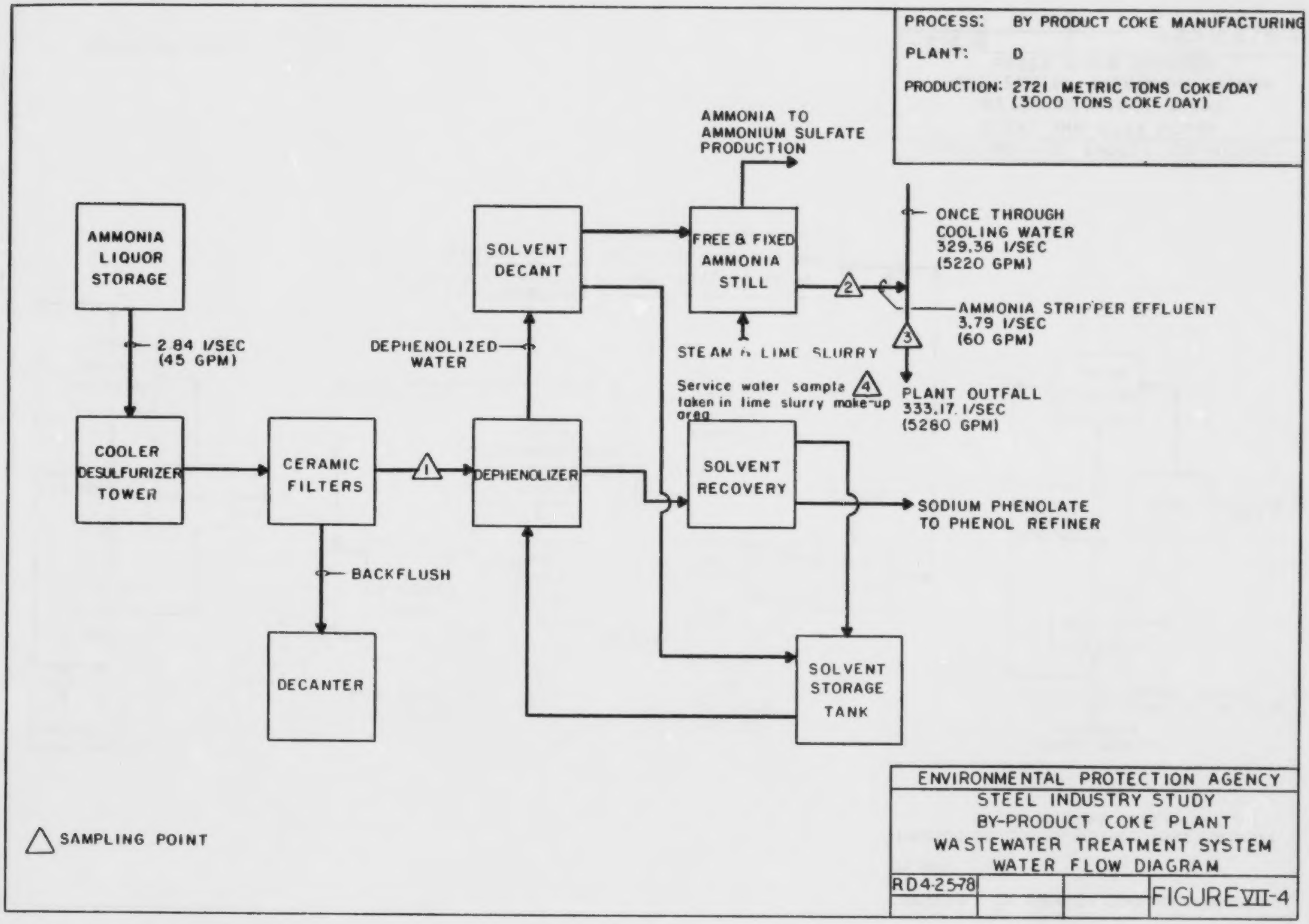
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-3

PROCESS: BY PRODUCT COKE MANUFACTURING

PLANT: D

PRODUCTION: 2721 METRIC TONS COKE/DAY
(3000 TONS COKE/DAY)

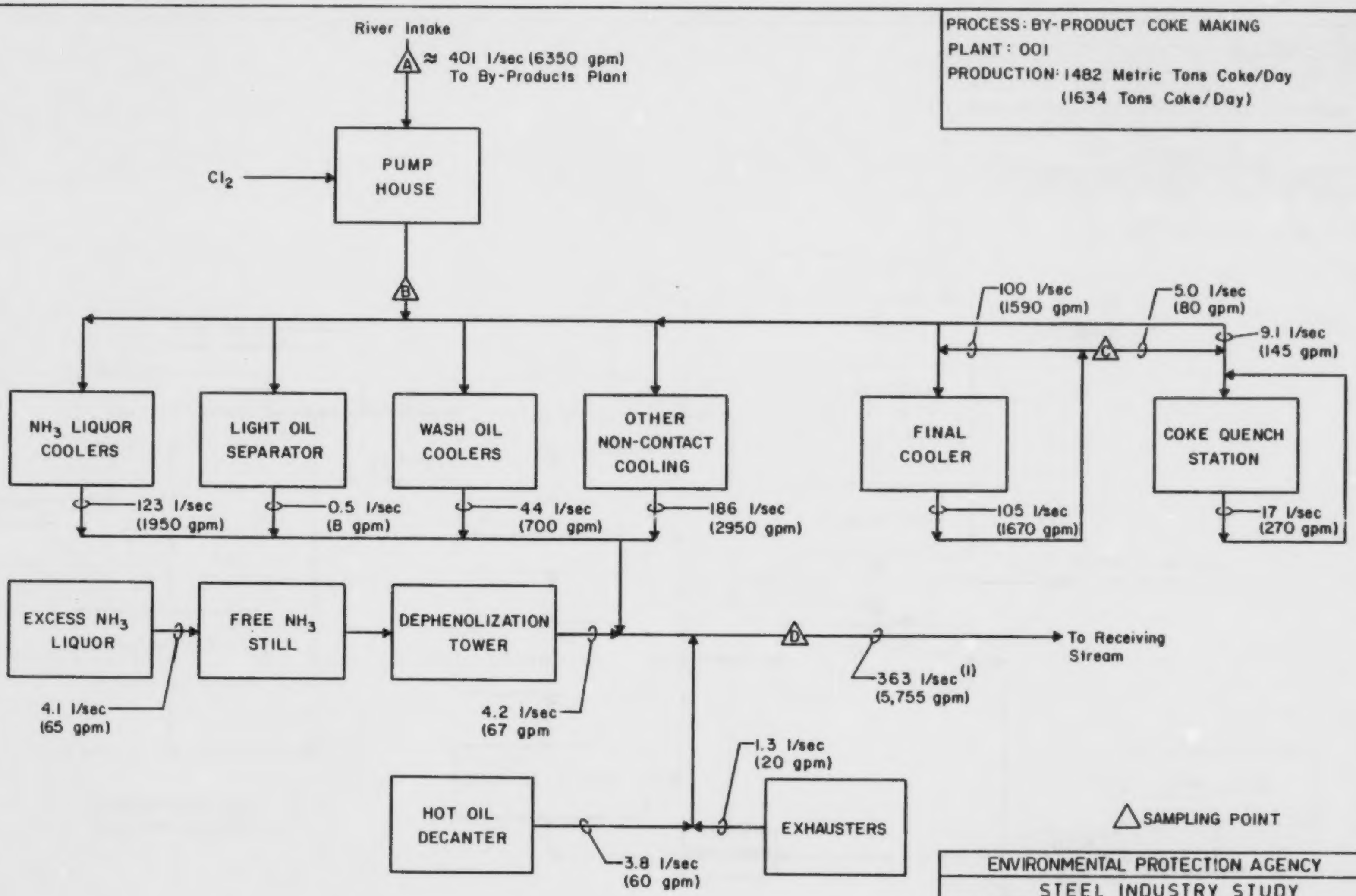

AMMONIA LIQUOR STORAGE
2.84 l/SEC (45 GPM)
COOLER DESULFURIZER TOWER
CERAMIC FILTERS
BACKFLUSH
DECANTER
1
DEPHENOLIZER
DEPHENOLIZED WATER
SOLVENT DECANT
AMMONIA TO AMMONIUM SULFATE PRODUCTION
FREE & FIXED AMMONIA STILL
STEAM & LIME SLURRY
2
ONCE THROUGH COOLING WATER 329.36 l/SEC (5220 GPM)
AMMONIA STRIPPER EFFLUENT 3.79 l/SEC (60 GPM)
3
PLANT OUTFALL 333.17 l/SEC (5280 GPM)
Service water sample taken in lime slurry make-up area
4
SOLVENT RECOVERY
SODIUM PHENOLATE TO PHENOL REFINER
SOLVENT STORAGE TANK
SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD4-25-78

FIGURE VII-4

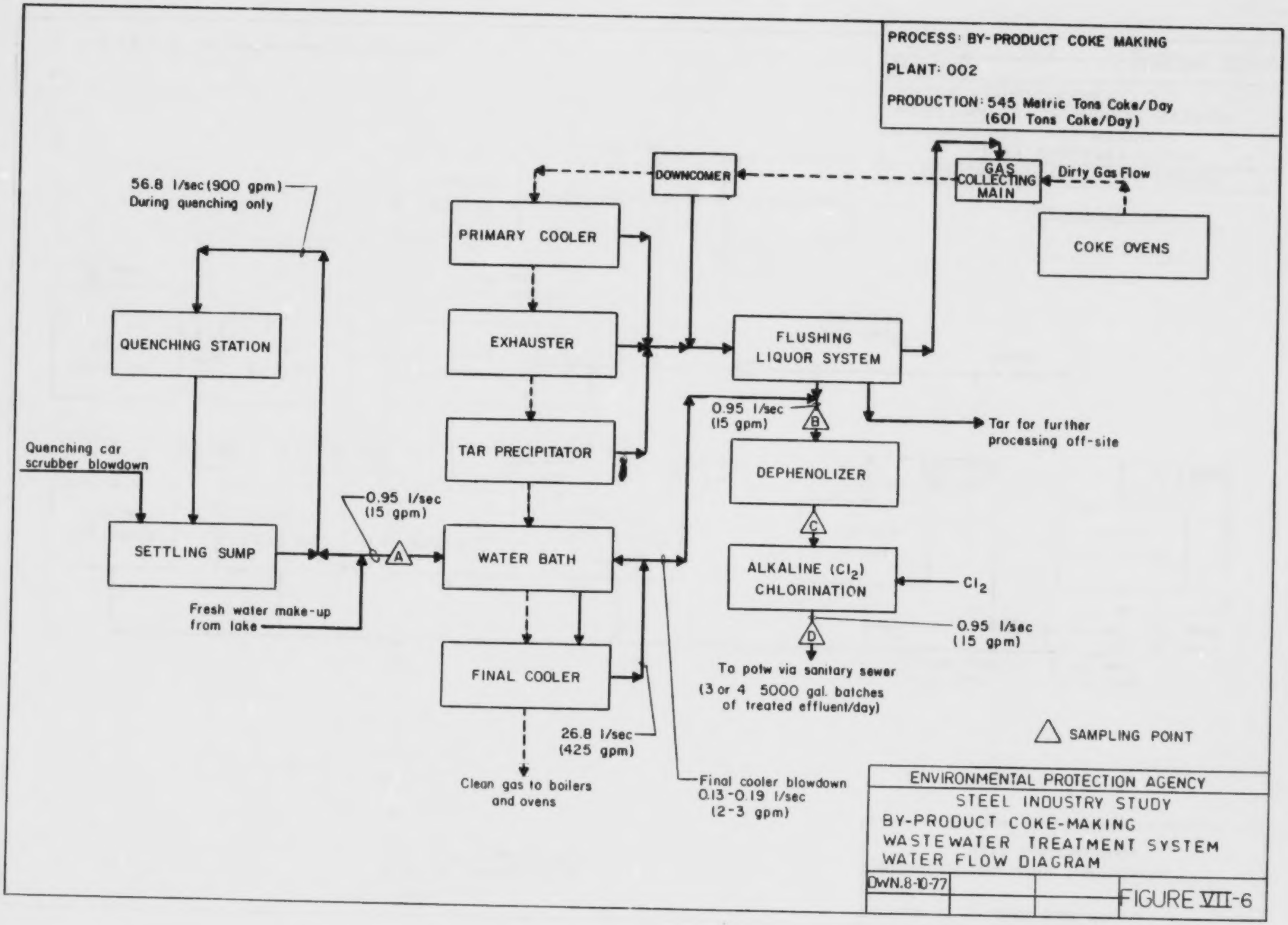
PROCESS: BY-PRODUCT COKE MAKING
PLANT: 001
PRODUCTION: 1482 Metric Tons Coke/Day
(1634 Tons Coke/Day)


River Intake
A
≈ 401 l/sec (6350 gpm)
To By-Products Plant
Cl_2
PUMP HOUSE
B
NH_3 LIQUOR COOLERS
LIGHT OIL SEPARATOR
WASH OIL COOLERS
OTHER NON-CONTACT COOLING
FINAL COOLER
COKE QUENCH STATION
100 l/sec (1590 gpm)
5.0 l/sec (80 gpm)
9.1 l/sec (145 gpm)
C
123 l/sec (1950 gpm)
0.5 l/sec (8 gpm)
44 l/sec (700 gpm)
186 l/sec (2950 gpm)
105 l/sec (1670 gpm)
17 l/sec (270 gpm)
EXCESS NH_3 LIQUOR
FREE NH_3 STILL
DEPHENOLIZATION TOWER
D
To Receiving Stream
363 l/sec(1) (5,755 gpm)
4.1 l/sec (65 gpm)
4.2 l/sec (67 gpm
1.3 l/sec (20 gpm)
HOT OIL DECANTER
EXHAUSTERS
3.8 l/sec (60 gpm)
SAMPLING POINT

(1) Only 2.6% of this total effluent is process water.

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCTS COKE-MAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
DWN. 8-10-77

FIGURE VII-5


56.8 l/sec (900 gpm)
During quenching only
QUENCHING STATION
Quenching car
scrubber blowdown
SETTLING SUMP
Fresh water make-up
from lake
0.95 l/sec
(15 gpm)
A
PRIMARY COOLER
EXHAUSTER
TAR PRECIPITATOR
WATER BATH
FINAL COOLER
DOWNCOMER
26.8 l/sec
(425 gpm)
Clean gas to boilers
and ovens
Final cooler blowdown
0.13-0.19 l/sec
(2-3 gpm)
FLUSHING
LIQUOR SYSTEM
0.95 l/sec
(15 gpm)
B
Tar for further
processing off-site
DEPHENOLIZER
C
ALKALINE (Cl_2)
CHLORINATION
Cl_2
0.95 l/sec
(15 gpm)
D
To potw via sanitary sewer
(3 or 4 5000 gal. batches
of treated effluent/day)
GAS
COLLECTING
MAIN
Dirty Gas Flow
COKE OVENS
△ SAMPLING POINT

PROCESS: BY-PRODUCT COKE MAKING

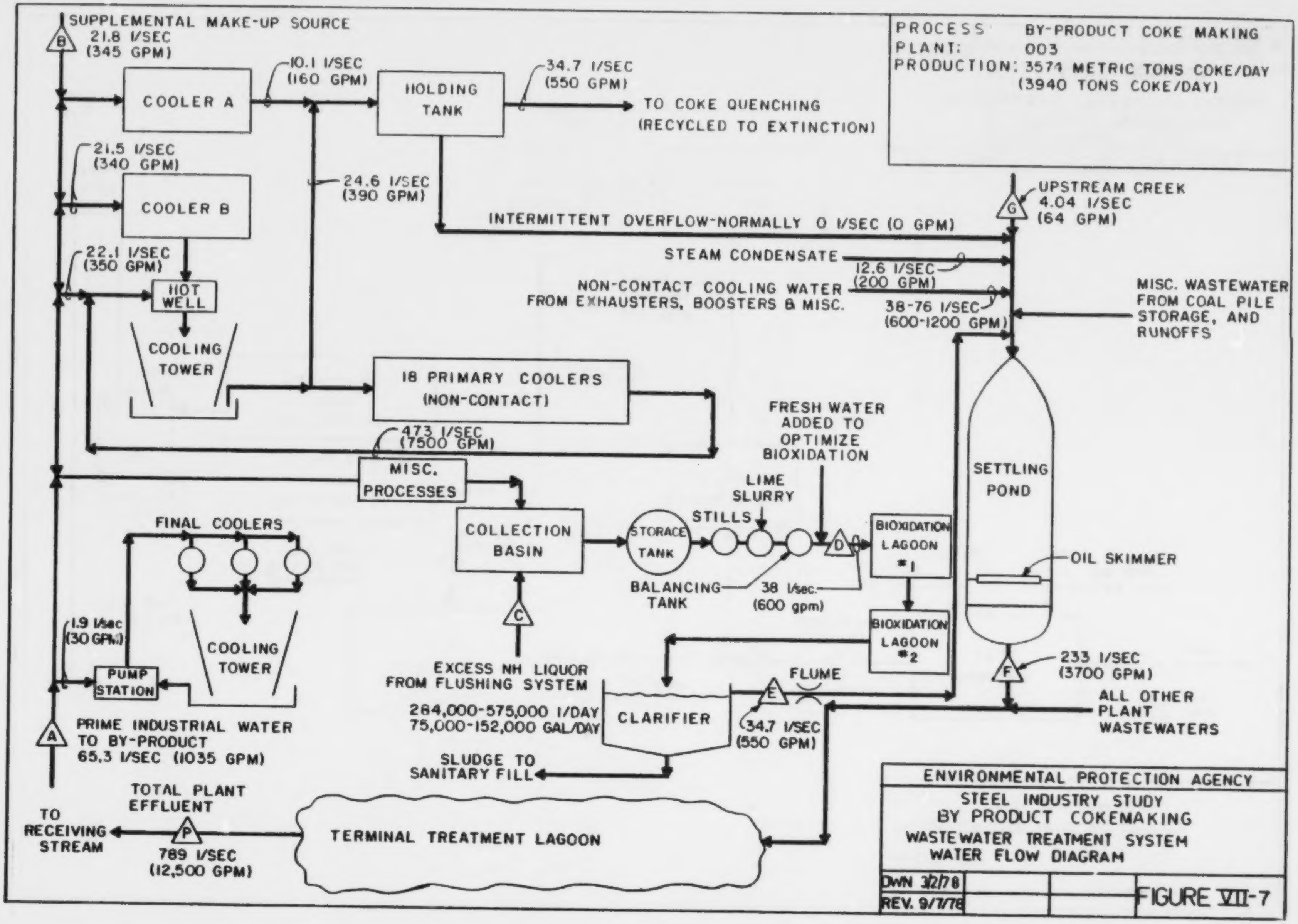
PLANT: 002

PRODUCTION: 545 Metric Tons Coke/Day
(601 Tons Coke/Day)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE-MAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

DWN. 8-10-77

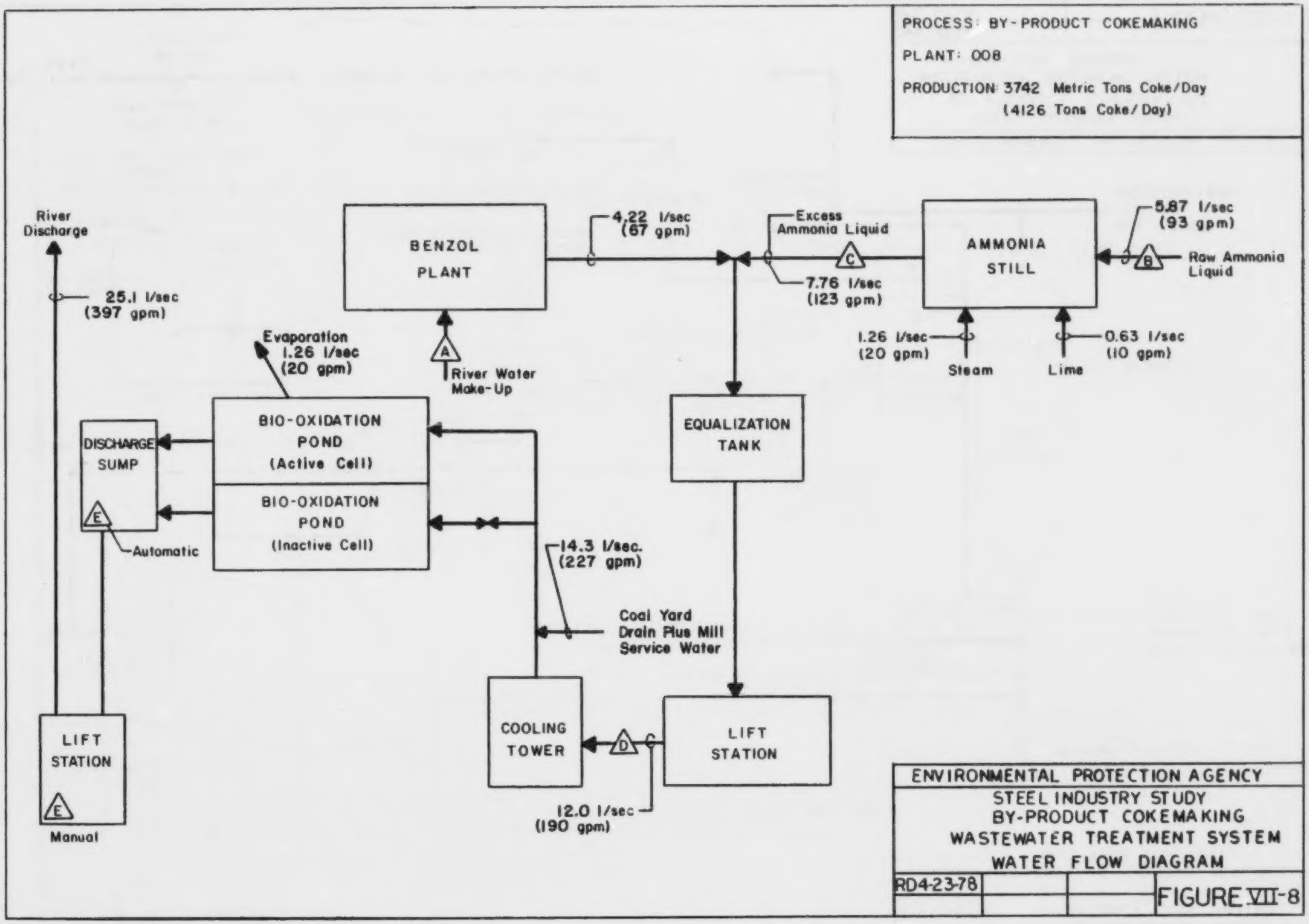
FIGURE VII-6


PROCESS BY-PRODUCT COKE MAKING
PLANT: 003
PRODUCTION: 3574 METRIC TONS COKE/DAY
(3940 TONS COKE/DAY)
SUPPLEMENTAL MAKE-UP SOURCE
B
21.8 l/SEC
(345 GPM)
COOLER A
10.1 l/SEC
(160 GPM)
HOLDING TANK
34.7 l/SEC
(550 GPM)
TO COKE QUENCHING
(RECYCLED TO EXTINCTION)
21.5 l/SEC
(340 GPM)
COOLER B
24.6 l/SEC
(390 GPM)
INTERMITTENT OVERFLOW-NORMALLY 0 l/SEC (0 GPM)
G
UPSTREAM CREEK
4.04 l/SEC
(64 GPM)
22.1 l/SEC
(350 GPM)
HOT WELL
COOLING TOWER
STEAM CONDENSATE
12.6 l/SEC
(200 GPM)
NON-CONTACT COOLING WATER
FROM EXHAUSTERS, BOOSTERS & MISC.
38-76 l/SEC
(600-1200 GPM)
MISC. WASTEWATER
FROM COAL PILE
STORAGE, AND
RUNOFFS
18 PRIMARY COOLERS
(NON-CONTACT)
473 l/SEC
(7500 GPM)
MISC. PROCESSES
FRESH WATER
ADDED TO
OPTIMIZE
BIOXIDATION
SETTLING POND
LIME SLURRY
STILLS
FINAL COOLERS
COLLECTION BASIN
STORAGE TANK
D
BIOXIDATION LAGOON #1
OIL SKIMMER
BALANCING TANK
38 l/sec.
(600 gpm)
1.9 l/sec
(30 GPM)
COOLING TOWER
C
BIOXIDATION LAGOON #2
PUMP STATION
EXCESS NH LIQUOR
FROM FLUSHING SYSTEM
F
233 l/SEC
(3700 GPM)
FLUME
E
ALL OTHER
PLANT
WASTEWATERS
A
PRIME INDUSTRIAL WATER
TO BY-PRODUCT
65.3 l/SEC (1035 GPM)
284,000-575,000 l/DAY
75,000-152,000 GAL/DAY
CLARIFIER
34.7 l/SEC
(550 GPM)
SLUDGE TO
SANITARY FILL
TOTAL PLANT
EFFLUENT
TO
RECEIVING
STREAM
P
789 l/SEC
(12,500 GPM)
TERMINAL TREATMENT LAGOON
DWN 3/2/78
REV. 9/7/78

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY PRODUCT COKEMAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-7


River Discharge
25.1 l/sec (397 gpm)
Evaporation 1.26 l/sec (20 gpm)
BENZOL PLANT
4.22 l/sec (67 gpm)
Excess Ammonia Liquid
C
7.76 l/sec (123 gpm)
AMMONIA STILL
5.87 l/sec (93 gpm)
B
Raw Ammonia Liquid
1.26 l/sec (20 gpm)
Steam
Lime
0.63 l/sec (10 gpm)
A
River Water Make-Up
DISCHARGE SUMP
E
Automatic
BIO-OXIDATION POND (Active Cell)
BIO-OXIDATION POND (Inactive Cell)
EQUALIZATION TANK
14.3 l/sec. (227 gpm)
Coal Yard Drain Plus Mill Service Water
LIFT STATION
E
Manual
COOLING TOWER
D
LIFT STATION
12.0 l/sec (190 gpm)

PROCESS: BY-PRODUCT COKEMAKING

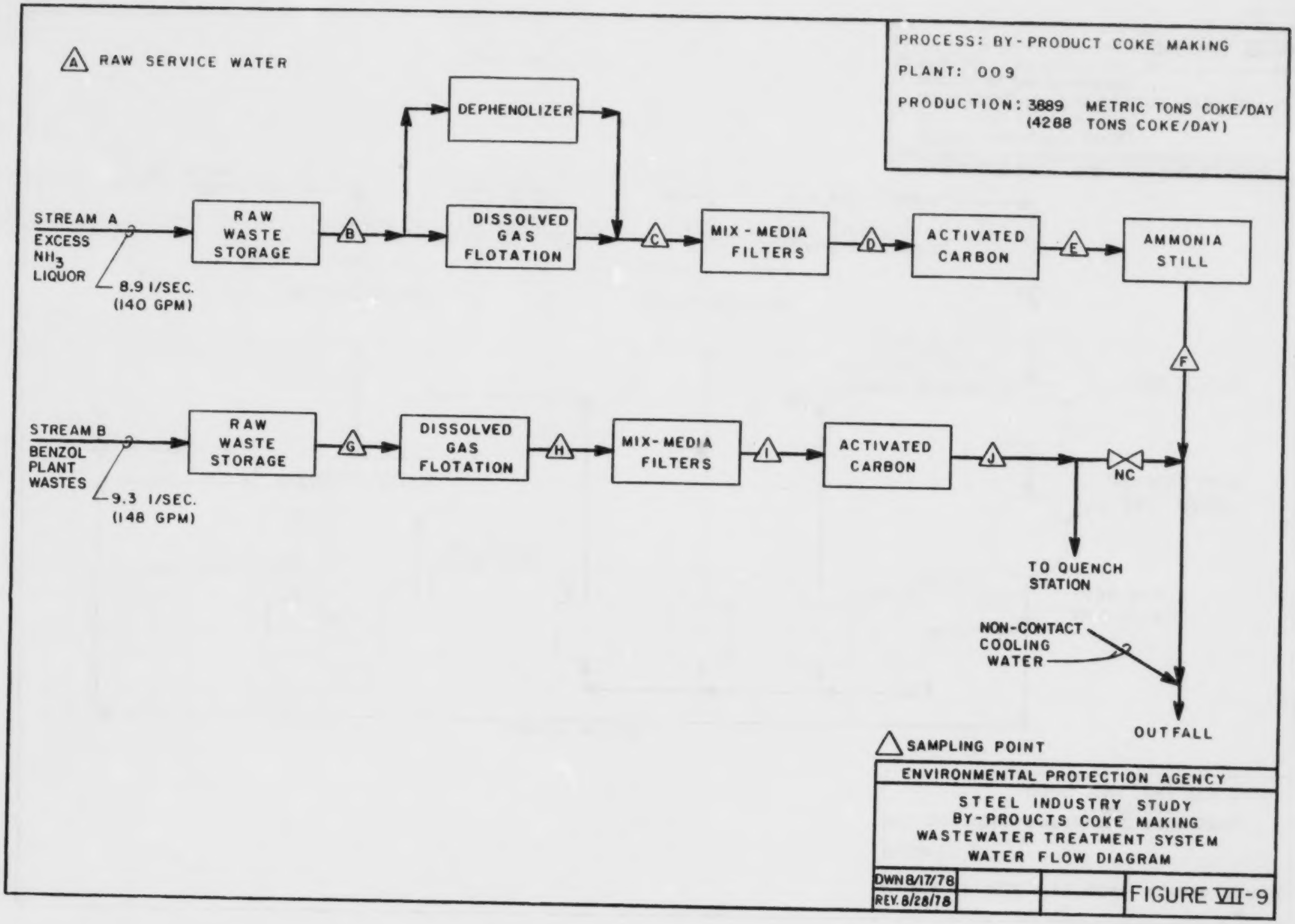
PLANT: 008

PRODUCTION: 3742 Metric Tons Coke/Day
(4126 Tons Coke/Day)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKEMAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD4-23-78

FIGURE VII-8


A RAW SERVICE WATER
STREAM A
EXCESS NH_3 LIQUOR
8.9 l/SEC. (140 GPM)
RAW WASTE STORAGE
B
DEPHENOLIZER
DISSOLVED GAS FLOTATION
C
MIX - MEDIA FILTERS
D
ACTIVATED CARBON
E
AMMONIA STILL
F
STREAM B
BENZOL PLANT WASTES
9.3 l/SEC. (148 GPM)
RAW WASTE STORAGE
G
DISSOLVED GAS FLOTATION
H
MIX - MEDIA FILTERS
I
ACTIVATED CARBON
J
TO QUENCH STATION
NC
NON-CONTACT COOLING WATER
OUTFALL
SAMPLING POINT
DWN 8/17/78
REV. 8/28/78

PROCESS: BY-PRODUCT COKE MAKING

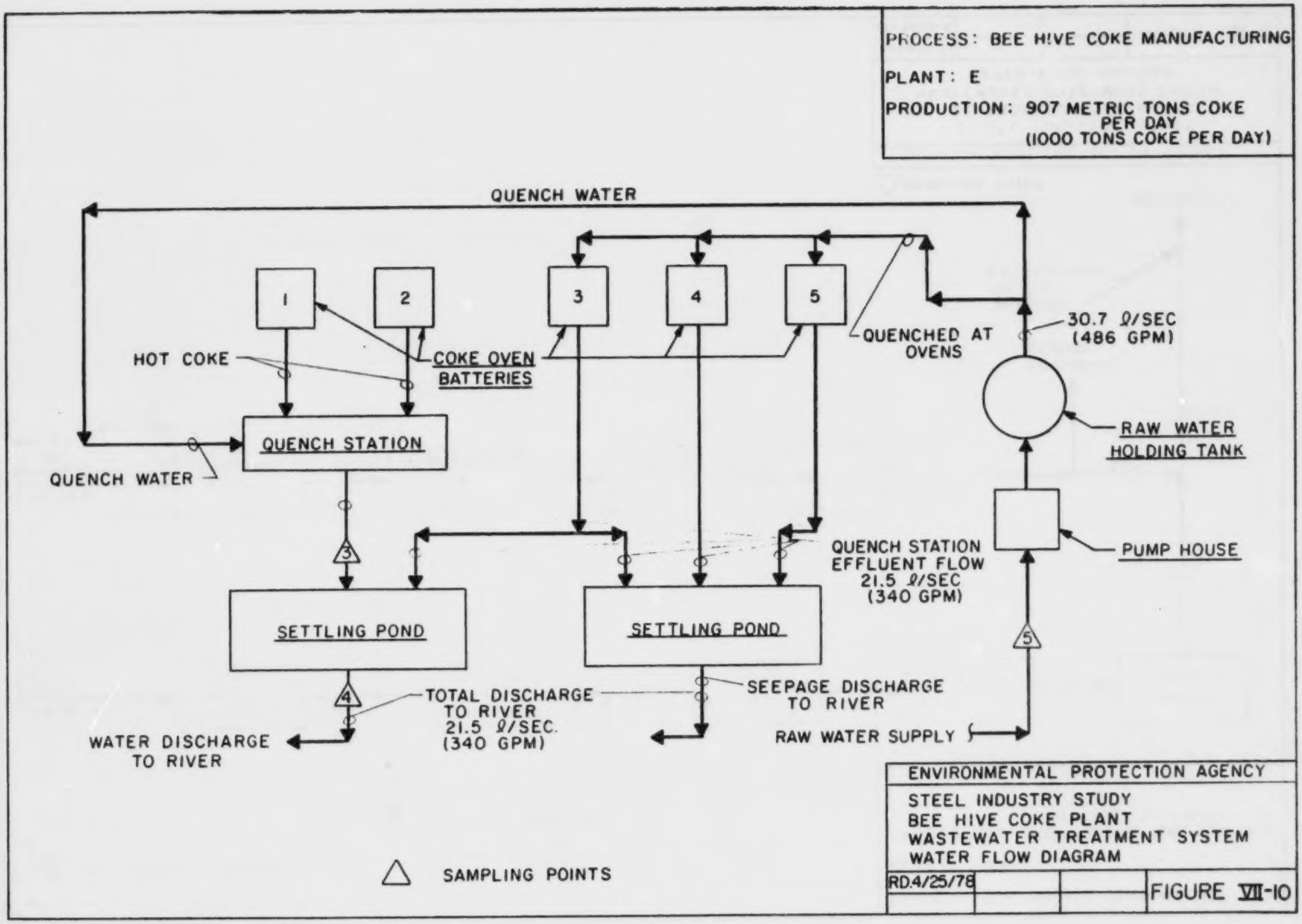
PLANT: 009

PRODUCTION: 3889 METRIC TONS COKE/DAY
(4288 TONS COKE/DAY)

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PROUCTS COKE MAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-9


QUENCH WATER
1
2
3
4
5
HOT COKE
COKE OVEN BATTERIES
QUENCHED AT OVENS
30.7 ℓ/SEC (486 GPM)
RAW WATER HOLDING TANK
QUENCH STATION
QUENCH WATER
PUMP HOUSE
QUENCH STATION EFFLUENT FLOW 21.5 ℓ/SEC (340 GPM)
3
SETTLING POND
SETTLING POND
5
4
TOTAL DISCHARGE TO RIVER 21.5 ℓ/SEC. (340 GPM)
SEEPAGE DISCHARGE TO RIVER
WATER DISCHARGE TO RIVER
RAW WATER SUPPLY
△ SAMPLING POINTS

PROCESS: BEE HIVE COKE MANUFACTURING

PLANT: E

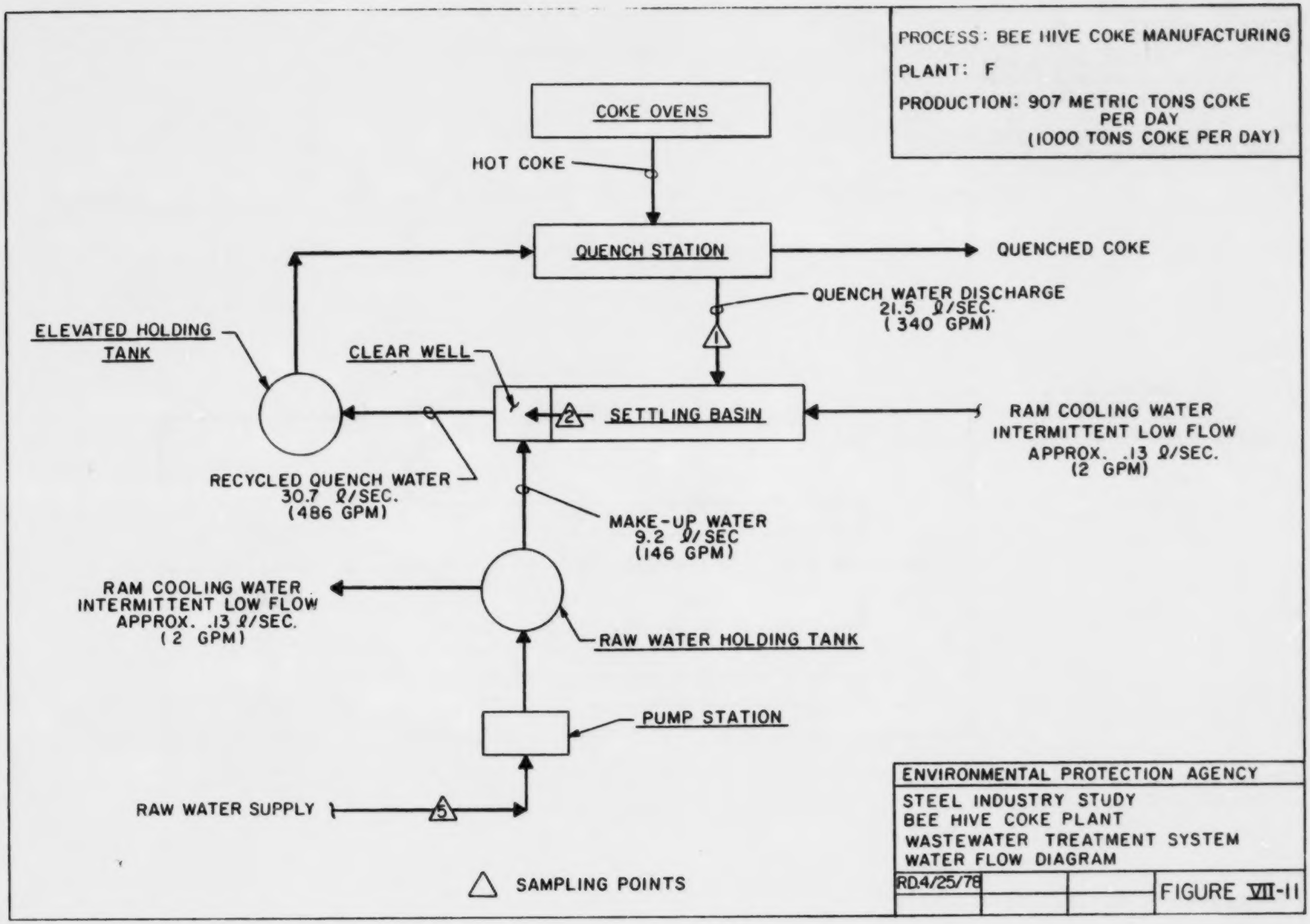
PRODUCTION: 907 METRIC TONS COKE PER DAY
(1000 TONS COKE PER DAY)

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEE HIVE COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD.4/25/78

FIGURE VII-10



PROCESS: BEE HIVE COKE MANUFACTURING
PLANT: F
PRODUCTION: 907 METRIC TONS COKE PER DAY (1000 TONS COKE PER DAY)
COKE OVENS
HOT COKE
QUENCH STATION
QUENCHED COKE
QUENCH WATER DISCHARGE 21.5 ℓ/SEC. (340 GPM)
1
ELEVATED HOLDING TANK
CLEAR WELL
2
SETTLING BASIN
RAM COOLING WATER INTERMITTENT LOW FLOW APPROX. .13 ℓ/SEC. (2 GPM)
RECYCLED QUENCH WATER 30.7 ℓ/SEC. (486 GPM)
MAKE-UP WATER 9.2 ℓ/SEC (146 GPM)
RAM COOLING WATER INTERMITTENT LOW FLOW APPROX. .13 ℓ/SEC. (2 GPM)
RAW WATER HOLDING TANK
PUMP STATION
RAW WATER SUPPLY
5
△ SAMPLING POINTS
RD.4/25/78

ENVIRONMENTAL PROTECTION AGENCY

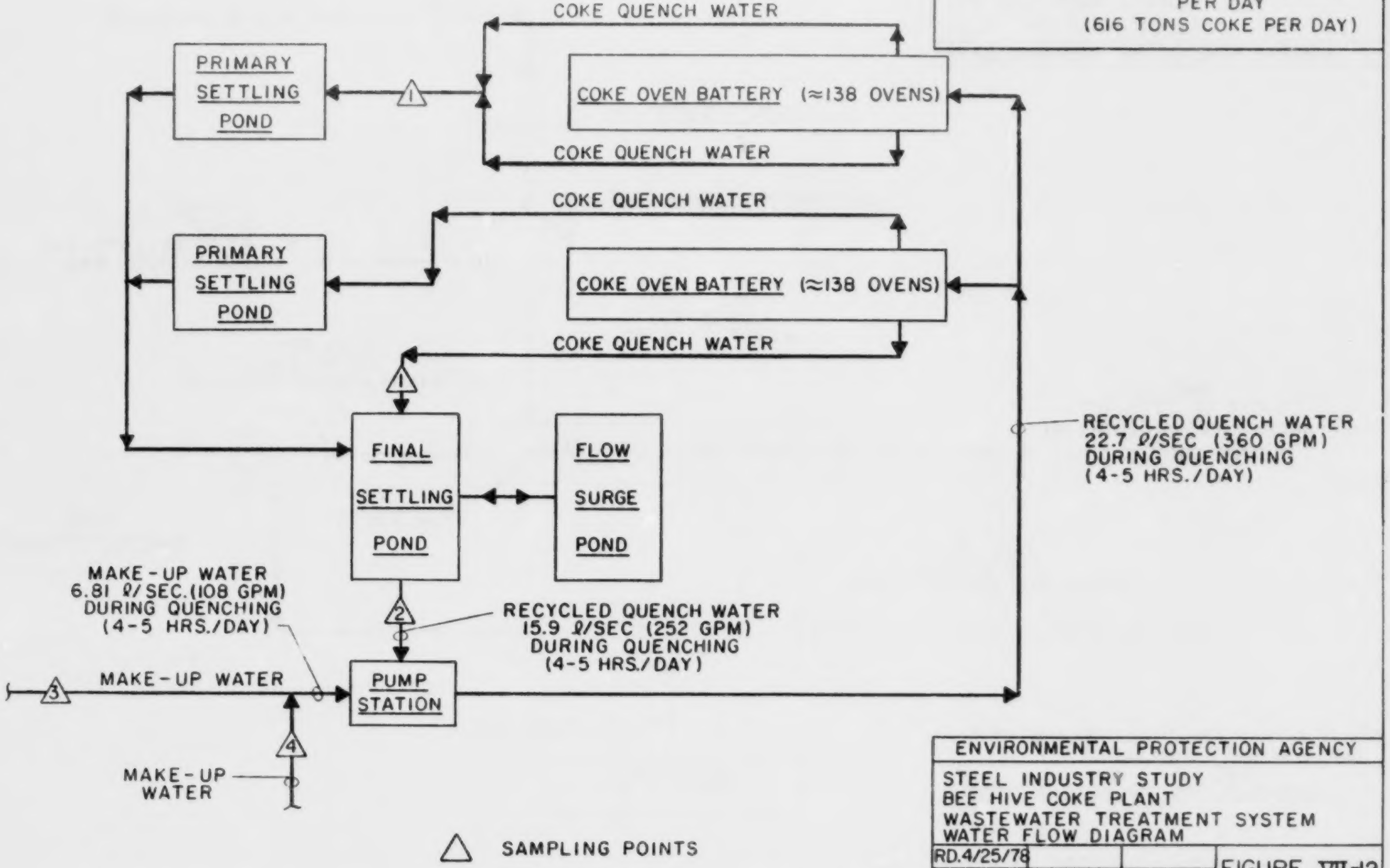
STEEL INDUSTRY STUDY
BEE HIVE COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-11

PROCESS: BEE HIVE COKE MANUFACTURING

PLANT: G

PRODUCTION: 558.7 METRIC TONS COKE PER DAY
(616 TONS COKE PER DAY)


COKE QUENCH WATER
PRIMARY SETTLING POND
1
COKE OVEN BATTERY (≈138 OVENS)
COKE QUENCH WATER
COKE QUENCH WATER
PRIMARY SETTLING POND
COKE OVEN BATTERY (≈138 OVENS)
COKE QUENCH WATER
1
FINAL SETTLING POND
FLOW SURGE POND
RECYCLED QUENCH WATER 22.7 ℓ/SEC (360 GPM) DURING QUENCHING (4-5 HRS./DAY)
MAKE-UP WATER 6.81 ℓ/SEC. (108 GPM) DURING QUENCHING (4-5 HRS./DAY)
2
RECYCLED QUENCH WATER 15.9 ℓ/SEC (252 GPM) DURING QUENCHING (4-5 HRS./DAY)
3
MAKE-UP WATER
PUMP STATION
4
MAKE-UP WATER
△ SAMPLING POINTS

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEE HIVE COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD.4/25/78

FIGURE VII-12

COKEMAKING SUBCATEGORY

SECTION VIII

COST, ENERGY, AND NONWATER QUALITY IMPACTS

Introduction

This section presents the estimated costs of applying the various alternative wastewater treatment systems. The analysis also considers the energy requirements and nonwater quality impacts (including sludge disposal and by-product recovery) associated with complying with the proposed BPT, BAT, BCT, NSPS, PSES, and PSNS limitations and standards.

Many of the basic components of the various model treatment systems are presently in use. In addition, as there are many possible combinations and variations of the treatment systems available which may achieve the proposed limitations and standards, not all plants will be required to add all of the treatment system components (or incur all of the incremental costs indicated) to bring facilities into compliance with the proposed limitations. Estimates of the capital investment required to bring all by-product and beehive coke plants into compliance with the proposed BPT and BAT limitations are presented in this section.

Costs for Actual Treatment Plants Serving By-Product Coke Operations

The water pollution control costs reported for plants visited during this study are presented in Tables VIII-1 and VIII-2 for by-product and beehive operations, respectively. The individual treatment systems, gross effluent loads, and reductions achieved are described in Section VII. The Agency estimated the costs of compliance from data supplied for the plants (all costs converted to July 1978 dollars). Standard cost of capital and depreciation percentages were used so that these basic costs would be comparable from plant to plant.

In general, the costs varied primarily with increasing sophistication of treatment systems, and secondarily with the size of the treatment system. The three biological oxidation plants (B, 003, and 008) have lower annual costs than do physical/chemical systems, especially energy and chemical costs.

Table VIII-3 provides a comparison of actual industry costs vs EPA estimated costs for facilities in-place at seven biological and five physical/chemical plants. Of the 12 investment and 11 annual costs which can be compared, the cost estimates based on the models were, in most cases, higher. This is usually the case because some plants are not treating the entire raw wastewater load but are disposing of portions by quenching or discharging without treatment. This practice allowed plants to have smaller facilities than those costed by the

Agency for its model treatment system which is designed to treat the entire raw wastewater flow.

Footnotes to Table VIII-3 provide information relating to other factors which contributed to the cost differences observed. Overall, model-based estimates are 15% higher than the industry's capital costs and 5.2% higher than the industry's annual costs. The Agency concludes that its model-based estimates accurately reflect the actual costs which will be incurred by the industry. As a whole, cost estimates based upon models are sufficiently generous to cover all initial actual investment costs including land acquisition and clearing, retrofitting new systems to old production facilities, and other site specific costs as well as the cost of capital equipment.

For beehive operations, capital and annual costs reported for three operating plants proved to be a small fraction of model-based estimates, primarily because the model includes a standard allowance for roadways, fencing and buildings associated with wastewater treatment, while the actual beehive plants either do not have such components, or do not report such costs. For beehive operations, the wastewater treatment components could usually be provided at low cost. For example, plant E installed a settling basin for less than $7,000 by using the natural contours of their site and a small earthen dike. The model estimate for the basin, including site preparation and excavation, would be about $36,000. In every case, model costs are at least four times greater than actual plant cost for beehive cokemaking operations.

Control and Treatment Technology (C&TT) Recommended for Use in Cokemaking Operations

The control and treatment technology (C&TT) in use or available for use for cokemaking operations is presented in Tables VIII-4 and VIII-5. It should be recognized that this regulation, when promulgated, will not require the installation of these C&TT steps. Any other alternative treatment system which achieves the limitations are acceptable. In addition to listing the treatment methods available, Tables VIII-4 and VIII-5 also present the following information:

1. Status and reliability
2. Problems and limitations
3. Implementation time
4. Land requirements
5. Environmental impact other than water
6. Solid waste generation

The levels of treatment, their respective costs, the pollutants removed, and the energy requirements and nonwater quality impacts associated with those levels of treatment are discussed below.

A. Treatment Costs

1. Proposed BPT Effluent Limitations

a. By-Product Cokemaking Operations

Certain steps which result in the reduction of pollutants in the wastewater are commonly practiced for the purpose of by-product recovery, and thus are not considered wastewater treatment technologies. Accordingly, these steps are not costed as wastewater treatment systems. Free ammonia stripping and dephenolization of the raw wastewaters fit this description, since their primary aim is the recovery of ammonium salts and sodium phenolates. Refer to Table VIII-6 for BPT model treatment component costs.

The Agency has calculated costs for facilities in-place at each by-product cokemaking plant, and has estimated the costs of the model system components which are required to enable individual plants to achieve the proposed BPT limitations (see Table VIII-7). The Agency identified two plants (0684F and 0732A) as employing physical/chemical systems because of the presence of key components (full scale activated carbon systems) while all other plants have been costed as biological treatment systems. The Agency believes the estimated BPT costs are reasonably accurate on the basis of the favorable cost comparisons shown in Table VIII-3. Table VIII-7 presents plant-by-plant model cost estimates of facilities in place and required to attain BPT. Industry-wide capital and annual costs associated with the attainment of the proposed BPT limitations are summarized in Table VIII-8.

b. Beehive Cokemaking Operations

The model BPT treatment system consists of collecting all quenchwater runoffs in a settling pond, and then recycling all pond overflows to the quenching station. A "no discharge" condition results. Refer to Table VIII-8 for cost information. Note that no additional expenditures are necessary for beehives to achieve compliance with the proposed BPT limitation.

2. Proposed BAT limitations

a. By-Product Cokemaking Operations

The initial capital investment and annual operating costs for a typical 3600 TPD by-product coke plant are shown in Table VIII-9. Applying these model costs to all operating cokemaking plants results in a total BAT capital cost of over 57 million dollars for BAT Alternative No. 1, 64 million dollars for BAT

Alternative No. 2 and 38 million dollars for BAT Alternative No. 3. Of these totals, approximately 12 million dollars have already been spent, with about 4 million dollars being spent for the two physical/chemical treatment plants. Annual operating costs for the BAT alternative treatment systems are approximately 9 million dollars for BAT Alternative No. 1, 24 million dollars for BAT Alternative No. 2, and 7 million dollars for BAT Alternative No. 3 respectively. About 105 million dollars of annual costs are required at the proposed BPT level of treatment.

b. Beehive Cokemaking Operations

Since beehive plants have achieved the proposed BPT limitation of no discharge of process wastewater pollutants, no additional technologies need be applied. No additional investment costs are incurred, and annual operating costs are the same as that for the BPT level of treatment.

3. Proposed BCT Limitations

a. By-Product Cokemaking Operations

Section 304(b)(4) of the Act requires that certain "conventional" pollutants be controlled by BCT limitations. The only "conventional" pollutants limited by the proposed BPT limitations for by-product cokemaking are TSS, oil and grease, and pH.

BCT controls involve an industry/POTW cost comparison test. Reference is made to Volume I for a complete description of the BCT cost test.

A summary of the incremental costs of removing TSS and oil and grease with three BCT alternative treatment systems described herein appears in Table VIII-10. As shown, costs in dollars per pound of TSS and oil and grease removed are less than equivalent costs for POTW treatment of these same wastes. Note that all BCT alternatives pass the cost test, and thus are considered to treat conventional pollutants at reasonable cost. For additional information on BCT, refer to Section XI.

b. Beehive Cokemaking Operations

Since zero discharge is the proposed BPT limitation for beehive cokemaking, the proposed BCT limitation is also zero discharge.

4. Proposed NSPS

a. By-Product Cokemaking Operations

Model costs have been developed for two NSPS alternatives. A new source must design and install the most effective demonstrated control and treatment technology available. Biological systems have demonstrated an ability to control the widest variety of pollutants. It is, therefore, the model treatment system for new sources. Refer to Table VIII-11 for NSPS model costs covering by-products cokemaking. Since this study did not include projections of industry capacity additions, no industry-wide projections are attempted here.

b. Beehive Cokemaking Operations

Refer to Table VIII-12 for NSPS costs applicable to beehive cokemaking operations. Technology is identical with the BPT model treatment system which achieves zero discharge of pollutants by total recycle. It is considered very unlikely, however, that any new beehive cokemaking source will be constructed due to the dominance of by-product cokemaking and the severe impact on air pollution from beehive operations.

5. Proposed Pretreatment Standards

a. By-Product Cokemaking Operations

Pretreatment Standards for New Sources (PSNS) are identical with the NSPS described above, and consequently, costs are the same as those shown in Table VIII-11. The alternative treatment systems considered by the Agency for Pretreatment Standards for Existing Sources are the same as the BAT Alternative Nos. 1 and 2. Costs for these alternatives are presented in Table VIII-13.

b. Beehive Cokemaking Operations

As noted earlier, since the remaining beehive cokemaking operations are located in areas remote from POTWs, and it is very unlikely that any new beehive operations will be built, the Agency is not proposing pretreatment standards for beehive cokemaking.

B. Summary of Pollutant Load Reductions for Each Level

The annual tons of the various pollutants removed from cokemaking wastewaters by complying with the proposed BPT limitations and each of the proposed BAT alternative treatment systems are shown in Table VIII-14. Overall, the proposed BPT limitations remove 82% of all pollutants, while the BAT model treatment system remove 97% (82.7% of the pollutants remaining after BPT). For beehive cokemaking the relatively low raw waste loads are completely eliminated by complying with the proposed BPT limitations.

C. Energy Requirements Due to Installation of Recommended Technologies

The various levels of treatment for cokemaking wastewaters all consume relatively low amounts of energy. The BPT model treatment system is the primary user of this energy. The coke oven gas used for fuel provides far more usable energy than is consumed in cleaning and conditioning the gas and treating its resulting wastewaters.

1. Energy Impact at BPT Levels

The Agency estimates that installing and operating the BPT model treatment systems at all cokemaking operations will consume 31.5 million kilowatts of electricity per year. This total includes 30.6 million kilowatts for biological treatment at 57 by-product plants, 0.6 million kilowatts for physical/chemical treatment at two by-product plants, and 0.3 million kilowatts for treating wastewaters at a single operating beehive cokemaking plant. This consumption represents 0.055% of the 57 billion kilowatts consumed by the entire steel industry in 1978, a relatively insignficant impact.

2. Energy Impact at all BAT/BCT Levels

Additional treatment components must be added to upgrade the BPT model treatment systems to the BAT model treatment systems. The additional energy requirements for each BAT alternative are shown in Table VIII-15. On an annual basis, BAT alternative treatment systems would consume, over and above BPT model treatment system requirements the following: 15.4 million kilowatts for Alternative 1; 23.4 million kilowatts for Alternative 2; and 6.1 million kilowatts for Alternative 3. Even the most energy intensive of these alternatives, Alternative 2, raises the total energy consumption per year for BPT and BAT to only 54.9 kilowatts, or less than 0.1% of the total industry consumption.

No additional energy is required to comply with the proposed BAT limitations for beehive operations, since they are the same as the proposed BPT limitations.

3. Energy Impacts at NSPS and Pretreatment Levels

Since NSPS, PSES, and PSNS model treatment systems are based upon technologies essentially identical to a combination of the proposed BPT and BAT/BCT model treatment systems their requirements are equivalent to the sum of the proposed BPT and BAT model requirements. Some minor amounts of energy can be saved by incorporating flow reduction techniques at the earliest possible level, thus reducing some equipment size and cost.

The estimated energy requirements for NSPS, PSES, and PSNS alternatives are based on a 3600 ton per day model size operating 365 days per year. NSPS and PSNS Alternative 1 would require 0.78 million kilowatts, and Alternative 2 would consume a total of 0.91 million kilowatts. For PSES, Alternative 1 consumes 0.50 million kilowatts, and Alternative 2 needs 0.60 million kilowatts per year.

D. Nonwater Quality Impacts

1. Air Pollution

Certain treatment steps in the BPT model treatment system are designed to return ammonia, hydrogen sulfide and hydrogen cyanide to the coke oven gas. If careful control of collectors, ductwork and piping is not practiced, some of these gases could escape to the atmosphere. In the biological treatment steps, a potential for odor exists if the biomass is not properly maintained. Systems which depend on incineration either by controlled combustion or recycle to extinction over quench towers (such as BAT Alternative 3) generate significant particulate carryover from high concentrations of dissolved solids in the wastewaters. These solids precipitate out and disperse over wide areas, even if the wastewaters are pretreated to remove regulated pollutants prior to evaporation. Except for BAT Alternative No. 3 (quenching with treated wastewaters) the Agency concludes that the water pollution control benefits associated with the control technologies considered herein outweigh any minor adverse air impacts that may result. Refer to Table VIII-4 for information on the specific control and technology steps which may generate air pollution.

2. Solids Waste Disposal

The use of lime to raise pH levels prior to fixed ammonia stripping produces 10 to 12 tons of sludge per day per plant in the form of unreacted calcium hydroxide, along with precipitated calcium carbonates and sulfates. The disposal of these sludges will impose costs, and care must be taken to prevent sludges from redissolving and entering streams as runoff from landfill sites. Sludges should be recycled where practical to consume as much as possible in process reactions. Lesser amounts of sludges are formed when caustic soda is used as the alkali, but caustic soda is more expensive than lime and the resultant dissolved solids discharge will be higher. Other sludges resulting from water treatment include coal or coke fines which are readily recycled to coke ovens. Also, the biological treatment systems generate some bacteriological sludges which require periodic disposal. Some plants, e.g., Plant B, transfer such sludges to a local POTW at very low flows (1 gpm), while others landfill these sludges along with sediment from settling ponds. Relatively little additional impact in the form of solids wastes results from application of the BAT alternative treatment systems. Small amounts of additional sludges will form, but will be only a fraction of those generated for disposal by the BPT model treatment system. Filter backwashes will become an added load for land disposal, but will contribute only a fraction of the BPT loads. These solids must be properly disposed of, and are subject to regulations under other applicable statutes. However, their environmental impacts are lessened by separating them from wastewater and controlling their disposal on land. Another solid waste load may result if the incremental amount of the recovered ammonium compound is too impure or otherwise not in demand for resale or reuse. While these are not really "sludges" resulting from wastewater treatment, their disposal may become a problem. A summary of the solid wastes generated by cokemaking operations per year is shown in Table VIII-16. Note that these data do not include any potential loads from unusable by-products recovered during treatment, as the Agency considers such disposal costs attributable primarily to production operations and not wastewater treatment.

E. Costs of Retrofit to Existing Systems

In addition to the cost comparison reported above and in Table VIII-3, the Agency attempted to isolate the actual costs expended to retrofit process wastewater treatment systems to existing production facilities. Nine coke plants were selected to provide detailed installation costs. Respondents were asked to itemize costs which would not have been incurred if treatment systems were installed simultaneously with construction, replacement or expansion of production facilities. Of the nine plants solicited, two provided no cost data, three replied that there were no retrofit costs applicable to their treatment systems, three reported retrofit costs of 2.7% to 6.9% of their total treatment plant costs, and one cited costs at 13.4% of total cost. These latter, higher percentage costs reflected the dismantling, relocation, and reassembly of a benzol plant. While this may have been necessary in this particular case to provide space for building a wastewater treatment plant, the cost of benzol plant reassembly is more correctly characterized as a process cost. If reassembly were backed out of retrofit cost for this site, the remaining retrofit items are 7.7% of treatment plant installation costs. The estimated on-site costs based on treatment plant model costs compares favorably with total actual costs reported by those plants solicited, including three of the four which provided retrofit cost data. After comparing these data, the Agency concludes its cost estimates based on the model plants are sufficiently generous to cover all normal retrofit costs. Only unusual site specific conditions would increase the cost of retrofit above the estimated costs. For most plants, the

Agency believes that retrofit costs will be a small fraction of total investment cost.

F. Water Consumption

The need to minimize flows by recycle of final cooler water and crystallizer barometric condenser water will have only minor impact on water consumption at by-product cokemaking operations. Water consumption attributable to wastewater treatment is estimated to increase to a total of 0.85 million gallons per day by the time all plants achieve the proposed BPT limitations and to 1.09 million gallons per day when the proposed BAT limitations are met. These losses are minor compared with the 22.6 million gallons currently evaporated during the quenching of hot coke on a typical production day. Based on these factors, the Agency concludes that the water consumption losses, on a nationwide basis, are justified when compared with the effluent reduction benefits attributable to compliance with the proposed BPT and BAT limitations.

The Agency also evaluated whether the establishment of a subdivision for plants located in arid or semi-arid regions was warranted. It found that the water loss for those plants is the same as for plants in other areas of the country. Moreover, the plants in water-short regions continue to use wet quenching stations, even though dry quenching technology is available and is currently practiced in other countries. The wet cooling towers at plants located in arid and semi-arid regions consume about 1 million gallons per day, which is 35 times the amount which will be consumed by complying with these proposed BPT and BAT limitations. In complying with the BPT and BAT proposed limitations, however, thousands of pounds of pollutants will not be discharged. Based on these factors and those discussed in Section XXX of Volume I of this Development Document, the Agency concludes that the amount of water which will consumed by plants located in arid and semi-arid regions is justified when compared to the effluent reduction benefits, and that establishing a subdivision for those plants with alternative effluent limitations is not justified.

Summary of Impacts

The Agency concludes that the effluent reduction benefits described below for the cokemaking subcategory outweigh any adverse impacts associated with energy consumption, air pollution, solid waste disposal, and water consumption.

Effluent Loadings (Tons/Year)

	Raw Waste	Proposed BPT	Proposed BAT
Flow, MGD	36.9	49.0	34.1
TSS	2,807	5,915	1,037
Oil and Grease	4,211	1,120	271
Ammonia (N)	33,690	7,514	861
Total Cyanide	2,807	2,240	171
Phenolic Compounds	16,845	40	3.6
Toxic Organics	6,654	309	37.2
Toxic Metals	152	58.2	23.8
Other Pollutants	35,374	1,158	738

TABLE VIII-1

EFFLUENT TREATMENT COSTS REPORTED BY PLANTS
BY-PRODUCT COKEMAKING

(All Costs Converted To 7/1/78 Dollars)

Plant Code	A	B	C	D
Reference Code	0432B	0112	0384A	0272
Initial Investment	4,069,000	1,209,400	6,919,600	3,450,800
Annual Costs				
Cost of Capital	175,000	52,000	297,500	148,400
Depreciation	406,900	120,900	692,000	345,000
Oper. & Maint.	242,700	79,700	238,200	301,200
Energy, Chemicals, & Power	1,671,200	48,800	1,467,300	7,600
TOTAL ANNUAL	2,495,800	301,400	2,695,000	802,200
$/Ton	1.31	0.163	1.03	0.732
$/1000 Gallons Treated	13.62	1.57	14.28	17.04

Plant Code	001	002	003	008	009
Reference Code	0732A	0464C	0868A	0920F	0684F
Initial Investment	977,400	No Cost Figures Reported by Plant	8,875,500	6,192,000	10,600,000
Annual Costs					
Cost of Capital	42,000		381,600	266,300	455,800
Depreciation	97,700		887,600	619,200	1,060,000
Oper. & Maint.	39,900		1,319,800	143,900	1,771,800
Energy, Chemicals, & Power	99,500		828,500	341,100	2,372,900
TOTAL ANNUAL	279,100		3,417,500	1,370,500	5,660,500
$/Ton	0.542		1.58	0.871	4.65
$/1000 Gallons Treated	3.69		16.25	6.36	63.56

TABLE VIII-2

EFFLUENT TREATMENT COSTS REPORTED BY PLANTS
BEEHIVE COKEMAKING

(All Costs Converted to 7/1/78 Dollars)

Plant Code	E	F	G
Initial Investment	$ 6,720	$12,600	$32,800
Annual Costs			
Cost of Capital	290	540	1,410
Depreciation	670	1,260	3,280
Oper. & Maint.	40,500	20,160	2,020
Energy & Power	0	0	1,140
TOTAL	$41,460	$21,960	$ 7,850
$/Ton	0.114	0.0602	0.0349
$/1000 Gal treated	0.232	0.123	0.284

TABLE VIII-3

COMPARISON OF COSTS FOR SURVEYED PLANTS (VISITS AND D-DCP'S) ESTIMATES BASED ON TREATMENT MODELS VERSUS PLANT DATA (ALL COSTS CONVERTED TO 7/1/78 DOLLARS)

Plant Codes	Cost Reported By Plants		Cost Estimated From Models		% Difference In Costs		Refer to Footnote(s)
	Capital	Annual(1)	Capital	Annual	Capital	Annual	
A-432B	4,069,000	2,495,800	5,837,000	1,875,200	+43.5	-24.9	(2),(6)
B-112	1,209,400	301,400	820,000	210,400	-32.2	-30.2	(2),(3),(6)
C-384A	6,919,600	2,695,100	8,487,500	2,718,300	+23.7	+0.9	(2),(4),(6)
D-272	3,450,800	802,200	4,354,000	1,369,400	+26.2	+70.7	
001-732A	977,400	279,100	0	0	-	-	(2),(5)
003-868A	8,875,500	3,417,500	8,893,600	3,125,400	+0.2	-8.5	
008-920F	6,192,000	1,370,500	6,624,000	2,277,000	+7.0	+66.1	
009-684F	10,600,000	5,660,500	8,877,000	3,577,800	-16.2	-36.8	(6),(7)
0012A	2,755,500	NR	3,875,000	1,153,300	+40.6	-	(2),(6)
0426	3,550,600	935,200	4,817,000	1,421,700	+35.7	+52.0	
0584F(B)	5,100,700	927,000	5,329,000	1,698,200	+4.5	+83.2	
0584F(M)	2,427,900	666,800	5,993,000	1,995,600	+146.8	+199.3	(2),(6),(8)
TOTALS	55,151,000	19,272,000	63,407,100	21,422,300	+15.0	+5.2	(9)

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(1) Standardized depreciation and capital recovery factors are used, along with plant's actual operating and maintenance costs.

(2) Plant treats only part of raw waste load. Some is discharged untreated, or disposed of via quenching.

(3) Plant adds more dilution water than model. Results in some oversized equipment.

(4) Plant discharges to POTW. Plant costs are for pretreatment only.

(5) Plant costs cover free still and dephenolizer while model considers these to be by-product recovery equipment only and assigns it no cost. Not included in totals.

(6) Plant strips ammonia from part of the raw waste only.

(7) Plant is designed to also treat wastes trucked in from an off-site cokemaking operation.

(8) Wastes from plant M are partly treated in plant B, providing certain cost reductions for M.

(9) Obtained by omitting plant 0012A from comparison, since that plant did not provide any annual costs.

NR: No annual cost data reported.

TABLE VIII-4

CONTROL AND TREATMENT TECHNOLOGIES
BY-PRODUCT COKEMAKING SUBCATEGORY

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
A. Combine flows from benzol plant, final cooler blowdown & misc. proc. with excess flushing liquor. Pass through free still (recovery step). Adjust pH of still effluent with lime or caustic soda to pH 10-12.	Done only if plant intends to follow with Step B. Used by 60% of all plants.	Increased chemical costs. Significant solids loads, which cannot be discharged without further treatment.	1-2 months	5000 sq.ft. (50'x100')	Some NH_3 may be released to atmosphere.	Produces 6-8 tons of sludge/day with lime, 2/3 to 1-1/3 tons/day with caustic. Primarily calcium hydroxides, carbonates & sulfates with lime.
B. Treat discharge of A via fixed still with lime leg for removal of fixed ammonia.	19 plants strip with lime. 4 plants strip with caustic. 17 plants have fixed stills which are inactive; most use lime.	Significant cost to operate & maintain; needs steam source, heated discharge; potential problem with scaling & plugging; discharge needs further treatment.	6-8 months	10,000 sq.ft. (100'x100')	Same as in A.	Sludges from A are still in system.
C. Treat discharge of B plus benzol plant wastes, final cooler blowdown, crystallizer, desulfurizer & misc. process wastewaters via sedimentation in a settling pond or lagoon with 1 day retention time.	Widely practiced, but not always with sufficient retention time.	Land requirements; generates sludges which must be removed periodically.	4-6 months	40,000 sq.ft. (200'x200')	Potential for producing objectionable odors; aesthetically unattractive.	Sludges formed at A must be periodically removed via clamshell & transferred to controlled landfill.

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
BY-PRODUCT COKEMAKING SUBCATEGORY
PAGE 2

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
D. Treat discharge C by neutralization with acid.	Can be readily done at modest cost; necessary adjustment of pH prior to discharge.	Additional chemical cost to neutralize chemicals added in Step A.	1 month	No additional space necessary.	Potential for releasing trace amounts of HCN & H_2S to atmosphere.	None. Actually may redissolve some unreacted lime.
E. Aerate total flow via the use of air blowers or vigorous mechanical agitation.	Practiced by 12 plants in this industry and subcategory.	Requires maintenance and energy input.	3-4 months	2,500 sq.ft. (50'x50')	Potential for odor & noise problems.	Some additional sludges form on aeration; about 100-150 lbs/day.
F. Treat the effluent of E via activated sludge(single stage) basin, complete with clarifier; if necessary add up to 50 GPT of fresh water to optimize bio-oxidation.	Practiced by 16 plants in this subcategory.	Must control sudden surges which would upset biota; tendency to foam if not controlled.	12-15 months	40,000 sq.ft. (200'x200')	Potential for odors. Promotes sludge formation. Foams are biologically active.	Sludges from E still in system.
G. Add vacuum filtration of sludge lagoon and clarifier underflows (last step in BPT).	Widely practiced in industry & by some plants in this subcategory.	Needs maintenance.	4-6 months	1,200 sq.ft. (30'x40')	Sludges require disposal at controlled landfill sites.	Removes 100-150 #/day to landfill.
H. Reduce flows by recycling crystallizer wastewaters, and blowdown to treatment at 4% of applied rate; replace up to 50 GPT of optimization water with blowdown from air pollution emission scrubbers; dispose of excess scrubber blowdown (from pushing only) via quenching.	Practiced by some plants in this subcategory.	Crystallizer wastewater recycle only applies to 14 plants; others have lower flows to begin with; APC blowdowns may require equalization prior to treatment.	4-6 months	No additional space necessary.	None	None

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
BY-PRODUCT COKEMAKING SUBCATEGORY
PAGE 3

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
I. Provide additional aeration via the use of blowers or vigorous mechanical agitation.	See Step E.	Requires maintenance and energy input.	3-4 months	2,500 sq.ft. (50'x50')	Potential for odor & noise problems.	Some additional sludges form in reactors.
J. Install second stage of activated sludge treatment, including clarifier and sludge recycle system.	Practiced by six plants in this subcategory.	Must control sudden surges in order to protect biota.	12-15 months	40,000 sq.ft. (200'x200')	Produces some additional sludges.	100-150 #/day of biologically active sludge to landfill.
K. Treat the effluent from J via filtration (last step in BAT 1).	Widely used in this industry and by two plants in this subcategory.	Increased capital and operating costs. Care musts be exersized in backwashing procedures. Hydraulic and solids overloads must be minimized.	15-18 months	2,400 sq.ft. (60'x40')	Filter backwash generates sludges.	600-800 lbs/ day of biologically active sludge.
L. Treat the effluent from J via the addition of powdered activated carbon to the bio-reactors. Follow up with Step K. (Last step in BAT 2).	Practiced in other industries and pilot-tested at one plant in this subcategory.	Significant increases in capital and operating costs.	10-12 months	2,400 sq.ft. (40'x60')	None	600-800 lbs/ day of spent carbon cannot be reactivated, and must be disposed of via coke ovens or landfill.
M. Pump effluent from Step K (either of the above variations) to quenching station as make-up to system. Recycle to extinction (last step in BAT alternative 3).	Current practice quenches with contaminated wastewater at many plants, but at least one treats to this degree prior to quench.	Considerable treatment cost to ultimately evaporate the water.	2-4 months	No additional space necessary.	Remaining contaminants go off to atmosphere.	None. Coke fines are normally recycled.

TABLE VIII-5

CONTROL AND TREATMENT TECHNOLOGIES
BEEHIVE COKEMAKING SUBCATEGORY

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
A. Install settling pond to collect coke fines. No reduction in flows.	Practiced in this subcategory. Pond must be periodically cleaned of settled fines.	High thermal load.	1 month	20,000 sq.ft. (100'x200') for settling pond.	By their very nature, beehive operation discharges pollutants to the atmosphere.	Coke fines, which can be reused.
B. Complete recycle - no aqueous blowdown. Makeup water required. Critical parameters reach equilibrium.	Widely practiced in this subcategory. Requires attention to prevent leaks or overloads.	Higher operating temperatures. Steam problems in winter.	2-4 months	No additionl space.	Same as treatment Step A.	Same as treatment Step A.

TABLE VIII-6

BPT TREATMENT MODEL COST DATA: 7/1/78 DOLLARS

Subcategory: By-Product Cokemaking

Model Size-TPD : 3600
Oper. Days/Year: 365
Turns/Day : 3

C&TT Steps	$A^{(3)}$	$B^{(3)}$	C	D	E	$F^{(4)}$	$G^{(4)}$	Total
Investment $ x 10^{-3}	225	4628	156	69	88	300	252	5718
Annual Cost $ x 10^{-3}								
Capital	9.7	199.0	6.7	2.9	3.8	12.9	10.8	245.8
Depreciation	22.5	462.8	15.6	6.9	8.8	30.0	25.2	571.8
Operation and Maintenance	7.9	162.0	5.5	2.4	3.1	10.5	8.8	200.2
Sludge Disposal	-	-	25.9	-	-	-	0.1	26.0
Energy and Power(1)	2.5	2.5	1.2	1.3	0.8	1.6	3.5	13.4
Chemical Costs	178.9	20.8	-	5.1	-	-	-	204.8
Steam Generation	-	520.3	-	-	-	-	-	520.3
TOTAL	221.5	1367.4	54.9	18.6	16.5	55.0	48.4	1782.3

Effluent Quality(2)	Raw Waste	Free Still Waste + Crystallizer	Treated Effluent Level
Flow, gal/ton	162	168	225
Ammonia	2000	600	100
Phenols	360	300	0.5
Cyanide, Total	75	50	5.0
Sulfide	200	150	1.0
Oil and Grease	75	75	10
Suspended Solids	50	50	80
Thiocyanate	500	480	2.0
pH (Units)	7-10	6-9	6-9

TABLE VIII-6
BPT TREATMENT MODEL COSTS
PAGE 2

Effluent Quality[(2)]		Raw Waste	Free Still Waste + Crystallizer	Treated Effluent Level
3	Acrylonitrile	2.0	1.2	0.10
4	Benzene	50	35	0.50
21	2,4,6-Trichlorophenol	0.1	0.1	0.02
22	Parachlorometacresol	0.8	0.6	0.05
23	Chloroform	0.4	0.2	0.20
34	2,4-Dimethylphenol	5.0	5.0	0.05
35	2,4-Dinitrotoluene	0.3	0.2	0.02
36	2,6-Dinitrotoluene	0.1	0.08	0.02
38	Ethylbenzene	4.0	3.0	0.10
39	Fluoranthene	1.0	0.8	0.10
54	Isophorone	0.6	0.5	0.20
55	Naphthalene	35	30	0.10
57	2-Nitrophenol	0.3	0.2	0.02
60	4,6-Dinitro-o-cresol	0.2	0.12	0.02
64	Pentachlorophenol	0.3	0.12	0.02
65	Phenol	320	275	0.40
66-71	Phthalates	5.0	5.0	1.0

TABLE VIII-6
BPT TREATMENT MODEL COSTS
PAGE 3

	Effluent Quality(2)	Raw Waste	Free Still Waste + Crystallizer	Treated Effluent Level
72	Benzo(a)anthracene	0.3	0.3	0.10
73	Benzo(a)pyrene	0.1	0.1	0.05
76	Chrysene	0.5	0.4	0.10
77	Acenaphthylene	4.0	3.5	0.10
80	Fluorene	0.6	0.6	0.10
84	Pyrene	0.8	0.6	0.20
86	Toluene	35	25	0.50
114	Antimony	0.2	0.2	0.10
115	Arsenic	2.0	2.0	0.40
125	Selenium	0.2	0.2	0.10
126	Silver	0.1	0.1	0.08
128	Zinc	0.2	0.2	0.10
131	Xylene	25	12	0.20

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(1) Costs are all power unless otherwise noted.
(2) All values are in mg/l unless otherwise noted.
(3)(4) Treatment components are used in tandem.

KEY TO C&TT STEPS

A: Lime Addition
B: Fixed Still
C: Sedimentation lagoon

D: Neutralization w/Acid
E: Aeration
F: Biological Treatment
G: Vacuum Filtration

TABLE VIII-6
NSPS TREATMENT MODEL COSTS
PAGE 4

Subcategory:	Beehive	Model Size-TPD	: 1000
:	Cokemaking	Operating Days/Year:	365
		Turns/Day	: 3

C&TT Step	1		Total
	A	B	
Investment $ x 10^{-3}	166	85	251
Annual Costs $ x 10^{-3}			
Capital	7.1	3.7	10.8
Depreciation	16.6	8.5	25.1
Operation & Maintenance	5.8	3.0	8.8
Sludge Disposal	7.2	-	7.2
Energy & Power(1)	-	6.2	6.2
TOTAL	36.7	21.4	58.1

Effluent Quality(2)	Raw Waste Load	Resulting Effluent Levels
Flow, gal/ton	300	0
Suspended solids	400	-
Ammonia (N)	0.35	-
Cyanide (Total)	0.004	-
Phenol (4AAP)	0.01	-
pH (Units)	6-9	-

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(1) Costs are all power unless otherwise noted.
(2) All values in mg/l unless otherwise noted.

TABLE VIII-7

BPT CAPITAL COST TABULATION

Subcategory: By-Product Cokemaking
: Biological Treatment Systems

Basis: 7/1/78 Dollars X 10^{-3}
: Facilities in place as of 1/1/78

Plant Code	TPD	C&TT Step A	B	C	D	E	F	G	In Place	Required	Total
0012A	2400	176	3629	122	54	69	235	198	4285	198	4483
0012B	1225	118	2424	82	36	46	157	132	2863	132	2995
0024A	3480	220	4535	153	68	86	294	247	4908	695	5603
0024B	2150	165	3397	115	51	65	220	185	115	4083	4198
0060	5150	279	5737	193	86	109	372	312	6209	879	7088
0060A	1930	155	3184	107	47	61	206	173	3652	281	3933
0060F	1045	107	2203	74	33	42	143	120	0	2722	2722
0112	5840	301	6187	209	92	118	401	337	7308	337	7645
0112A	9800	410	8440	284	126	160	547	460	9841	586	10427
0112B	8140	367	7551	255	113	144	489	411	7918	1412	9330
0112C	4600	261	5361	181	80	102	348	292	6151	474	6625
0112D	6670	326	6700	226	100	127	434	365	226	8052	8278
0212	1086	110	2255	76	34	43	146	123	76	2711	2787
0248A	1200	116	2394	81	36	46	155	130	2627	331	2958
0256E	1145	113	2328	78	35	44	151	127	0	2876	2876
0272	3004	202	4152	140	62	80	269	226	4494	637	5131
0280B	940	101	2068	70	31	39	134	113	0	2556	2556
0304	360	57	1163	39	17	22	75	63	1220	216	1436
0320	4340	252	5177	175	77	98	336	282	5429	968	6397
0348A	1000	104	2146	72	32	41	139	117	72	2579	2651
0380	400	60	1238	42	18	24	80	67	1298	231	1529
0384A	11684	456	9379	316	140	178	608	511	9835	1753	11588
0396A	1740	145	2992	101	45	57	194	163	57	3640	3697
0396C	814	92	1897	64	28	36	123	103	0	2343	2343
0426	2760	192	3946	133	59	75	256	215	4661	215	4876
0432A	6946	334	6865	231	102	131	445	374	0	8482	8482
0432B	5300	284	5837	197	87	111	378	318	197	7015	7212
0448A	4100	243	5004	169	75	95	324	272	169	6013	6182
0464B	530	71	1466	49	22	28	95	80	0	1811	1811
0464C	625	79	1619	55	24	31	105	88	0	2001	2001
0464E	2047	160	3298	111	49	63	214	180	3895	180	4075

TABLE VIII-7
CAPITAL COST TABULATION-BY-PRODUCT COKEMAKING
PAGE 2

Plant Code	TPD	C&TT Step A	B	C	D	E	F	G	In Place	Required	Total
0492A	1214	117	2411	81	36	46	156	131	81	2897	2978
0538A	450	65	1329	45	20	25	86	72	1394	248	1642
0584B	5400	287	5903	199	88	112	383	321	0	7293	7293
0584C	2600	185	3807	128	57	72	247	207	3992	711	4703
0584F(B)	3600	225	4628	156	69	88	300	252	5466	252	5718
0584F(M)	4500	257	5291	178	79	101	343	288	6249	288	6537
0656A	800	91	1877	63	28	36	122	102	63	2256	2319
0684A	2970	200	4123	139	61	78	267	225	139	4954	5093
0684B	1852	151	3106	105	46	59	201	169	105	3732	3837
0684D	576	75	1541	52	23	29	100	84	52	1852	1904
0684F	4736	265	5456	184	81	-	-	-	5905	81	5986
0684H	1369	126	2591	87	39	49	168	141	2804	397	3201
0684I	2372	175	3603	121	54	69	234	196	4202	250	4452
0684J	1066	108	2230	75	33	42	145	121	2413	341	2754
0732A	2025	159	3277	110	49	-	-	-	3546	49	3595
0856A	20780	644	13250	447	198	252	859	721	16371	0	16371
0856F	3000	202	4148	140	62	79	269	226	4552	574	5126
0856N	4468	256	5268	178	79	100	342	287	0	6510	6510
0860A	1580	137	2824	95	42	54	183	154	95	3394	3489
0860B	11960	462	9512	321	142	181	617	518	321	11432	11753
0864A	3558	223	4596	155	69	87	298	250	4974	704	5678
0868A	6866	331	6818	230	102	130	442	371	8424	0	8424
0920B	1836	150	3090	104	46	59	200	168	3344	473	3817
0920F	5205	281	5774	195	86	110	374	314	6625	509	7134
0946A	1000	104	2146	72	32	41	139	117	72	2579	2651
0948A	3816	233	4793	162	71	91	311	261	162	5760	5922
0948C	4000	240	4930	166	74	94	320	268	5336	756	6092
									*174,193	*124,701	*298,894

*Totals do not include confidential plants
Note: Underlined costs represent facilities in place.

Key to C&TT Steps
A: Lime Addition
B: Ammonia Still, Fixed
C: Sedimentation Lagoon
D: Neutralization with Acid
E: Aeration
F: Biological Treatment
G: Vacuum Filtration

TABLE VIII-8

BPT COST REQUIREMENTS
COKEMAKING SUBCATEGORY

(All Costs in 7/1/78 Dollars)

	Capital Investment Costs			Annual Costs		
	In-Place	Required	Total Capital	Current(1)	Additional(2)	Total Annual(3)
By-Product Cokemaking						
57 Biological Systems	168,400,000	124,800,000	293,200,000	58,300,000	43,300,000	101,600,000
2 Physical/Chemical Systems	9,450,000	130,000	9,580,000	3,200,000	100,000	3,300,000
By-Product Subtotal	177,850,000	124,930,000	302,780,000	61,500,000	43,400,000	104,900,000
Beehive Cokemaking	780,000	0	780,000	60,000	0	60,000
Cokemaking Total	178,780,000	125,200,000	303,980,000	61,560,000	43,400,000	104,960,000

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(1) Annual operating cost for BPT treatment components already in place.
(2) Annual operating cost for BPT treatment components which are yet to be installed to attain BPT limits.
(3) Total projected annual operating cost to attain BPT limits.

TABLE VIII-9

ALTERNATIVE BAT MODEL COST: BASIS 7/1/78 DOLLARS

Subcategory: By-Product Cokemaking

Model Size-TPD : 3600
Oper. Days/Year: 365
Turns/Day : 3

	1					2-H, I, & J Plus:			3-H, I, & J Plus:	
C&TT Steps	H	I	J	K	Total	$L^{(3)}$	$K^{(3)}$	Total Incl. H, I, J	M	Total Incl. H, I, J
Investment $ x 10^{-3}	45	88	300	438	871	52	438	923	220	653
Annual Cost $ x 10^{-3}										
Capital	1.9	3.8	12.9	18.8	37.4	2.2	18.8	39.6	9.5	28.1
Depreciation	4.5	8.8	30.0	43.8	87.1	5.2	43.8	92.3	22.0	65.3
Operation & Maintenance	1.6	3.1	10.5	15.3	30.5	1.8	15.3	32.3	7.7	22.9
Energy and Power$^{(1)}$	1.2$^{(2)}$	0.8	1.6	4.1	6.5	3.3	4.1	9.8	4.1$^{(2)}$	2.4
Chemical Costs	-	-	-	-	-	-	-	-	-	-
Powdered Activated Carbon	-	-	-	-	-	233.0	-	233.0	-	-
TOTAL	8.0$^{(2)}$	16.5	55.0	82.0	161.5	245.5	82.0	407.0	39.2$^{(2)}$	118.7

	Effluent Quality$^{(4)}$	BAT Feed Level	BAT 1 Effluent Level	BAT 2 Effluent Level	BAT 3 Effluent Level
	Flow, gal/ton	225	153	153	0
	Suspended Solids	80	20	20	-
	Ammonia (N)	100	15	15	-
	Phenols (4AAP)	0.5	0.025	0.025	-
	Cyanide (Total)	5	2.5	2.0	-
	Sulfide	1	0.4	0.3	-
	Oil and Grease	10	5	5	-
	Thiocyanate	2.0	1.0	0.5	-
	pH (Units)	6-9	6-9	6-9	-
3	Acrylonitrile	0.1	0.03	0.01	-
4	Benzene	0.5	0.05	0.05	-
21	2,4,6-Trichlorophenol	0.02	0.01	<0.01	-
22	Parachlorometacresol	0.05	0.01	0.01	-
23	Chloroform	0.2	0.10	0.05	-
34	2,4-Dimethylphenol	0.05	0.01	0.01	-
35	2,4-Dinitrotoluene	0.02	0.01	<0.01	-
36	2,6-Dinitrotoluene	0.02	0.01	<0.01	-
38	Ethylbenzene	0.10	0.02	0.01	-

TABLE VIII-9
ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS
BY-PRODUCT COKEMAKING
PAGE 2

Effluent Quality(4)		BAT Feed Level	BAT 1 Effluent Level	BAT 2 Effluent Level	BAT 3 Effluent Level
39	Fluoranthene	0.1	0.02	0.01	-
54	Isophorone	0.2	0.02	0.01	-
55	Naphthalene	0.1	0.01	0.01	-
57	2-Nitrophenol	0.02	0.01	<0.01	-
60	4,6-Dinitro-o-cresol	0.02	0.01	<0.01	-
64	Pentachlorophenol	0.02	0.01	<0.01	-
65	Phenol	0.4	0.01	0.01	-
(5)	Phthalates, Total	1.0	0.2	0.06	-
72	Benzo(a)anthracene	0.1	0.01	0.01	-
73	Benzo(a)pyrene	0.05	0.02	0.01	-
76	Chrysene	0.1	0.05	0.01	-
77	Acenaphthylene	0.1	0.03	0.02	-
80	Fluorene	0.1	0.02	0.01	-
84	Pyrene	0.2	0.04	0.02	-
86	Toluene	0.5	0.05	0.05	-
114	Antimony	0.1	0.10	0.10	-
115	Arsenic	0.4	0.25	0.25	-
125	Selenium	0.1	0.10	0.10	-
126	Silver	0.08	0.06	0.05	-
128	Zinc	0.1	0.10	0.10	-
130	Xylene	0.2	0.02	0.01	-

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for existing process water power requirements.
(3) Treatment components are used in tandem.
(4) All values are in mg/l unless otherwise noted.
(5) Sum of all phthalates-pollutants 66 through 71 (bis-2-ethylhexyl; butyl benzyl; di-n-butyl; di-n-octyl; diethyl; dimethyl phthalates).

KEY TO C&TT STEPS

H: 96% recycle of barometric condenser wastewaters; replace up to 50 GPT of dilution water by blowdowns from preheating or charging emission scrubbers.
J: Second activated sludge bio-oxidation unit, including clarifier
L: Addition of powdered activated carbon
I: Aeration
K: Filtration
M: Recycle treated effluent to extinction via quench tower

TABLE VIII-10

RESULTS OF BCT COST TEST
BY-PRODUCT COKEMAKING

A. BAT/BCT FEED

Effluent Concentration - Conventional Pollutants	90
Flow in MGD	0.81
Days per Year	365
Pounds per Year - Conventional Pollutants	221,915

B. BCT-1*

Effluent Concentration - Conventional Pollutants	20
Flow in MGD	0.55
Pounds per Year - Conventional Pollutants	41,855
Pounds per Year - Removed by Treatment	180,060
Annual Cost of BCT-1 ($)	145,000
$/Pound of Conventional Pollutant Removed	0.81 - PASS

C. BCT-2

Effluent Concentration - Conventional Pollutants	20
Flow in MGD	0.55
Pounds per Year - Conventional Pollutants	41,955
Pounds per Year - Removed by Treatment	180,060
Annual Cost of BCT-2 ($)	145,000
$/Pound of Conventional Pollutant Removed	0.81 - PASS

D. BCT-3

Effluent Concentration - Conventional Pollutants	0
Flow in MGD	0
Pounds per Year - Conventional Pollutants	0
Pounds per Year - Removed by Treatment	221,915
Annual Cost of BCT-3 ($)	102,200
$/Pound of Conventional Pollutant Removed	0.46 - PASS

MGD - Million gallons per day

Note: Costs based on by-product cokemaking model producing 3600 tons of coke per day. Beehives remain at BPT level.

*: Selected BCT Alternative.

TABLE VIII-11

NSPS AND PSNS MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: By-Product Cokemaking

Model Size-TPD : 3600
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	1									2-A Through G Plus:		
	A	B	C	D	E$^{(1)}$	F$^{(1)}$	G$^{(1)}$	H	Total	I$^{(1)}$	H$^{(1)}$	Total (Incl. A-G)
Investment $ x 10^{-3}	45	4127	156	69	176	450	252	438	5713	52	438	5765
Annual Cost $ x 10^{-3}												
Capital	1.9	177.5	6.7	3.0	7.6	19.4	10.8	18.8	245.7	2.2	18.8	247.9
Depreciation	4.5	412.7	15.6	6.9	17.6	45.0	25.2	43.8	571.3	5.2	43.8	576.5
Operation and Maintenance	1.6	144.4	5.5	2.4	6.2	15.8	8.8	15.3	200.0	1.8	15.3	201.8
Sludge Disposal	-	-	25.9	-	-	-	0.1	-	26.0	-	-	26.0
Energy and Power$^{(2)}$	1.2	4.9	1.2	1.3	1.6	1.6	3.5	4.1	19.4	3.3	4.1	22.7
Chemical Costs	-	199.6	-	5.1	-	-	-	-	204.7	-	-	204.7
Powdered Activated Carbon	-	-	-	-	-	-	-	-	-	233.0	-	233.0
Steam Generation	-	520.3	-	-	-	-	-	-	520.3	-	-	520.3
TOTAL	9.2	1459.4	54.9	18.7	33.0	81.8	48.4	82.0	1787.4	245.5	82.0	2032.9

	Effluent Quality$^{(4)}$	Raw Waste Level	NSPS and PSNS No.1 Effluent Level	NSPS and PSNS No.2 Effluent Level
	Flow, gal/ton	277$^{(3)}$	153	153
	Suspended Solids	90	20	20
	Ammonia (N)	1500	15	15
	Phenols (4AAP)	240	0.025	0.025
	Cyanide (Total)	150	2.5	2.0
	Sulfide	250	0.4	0.3
	Oil and Grease	100	5	5
	Thiocyanate	600	1	0.5
	pH (Units)	6-9	6-9	6-9
3	Acrylonitrile	1.0	0.03	0.01
4	Benzene	50	0.05	0.05
21	2,4,6-Trichlorophenol	0.2	0.01	0.01
22	Parachlorometacresol	0.4	0.01	0.01
23	Chloroform	0.3	0.10	0.05
0.0135	2,4-Dinitrotoluene	0.2	0.01	0.01
36	2,6-Dinitrotoluene	0.2	0.01	0.01
38	Ethylbenzene	4	0.02	0.01
39	Fluoranthene	0.8	0.02	0.01
54	Isophorone	0.5	0.02	0.01
55	Naphthalene	35	0.01	0.01
57	2-Nitrophenol	0.4	0.01	0.01

TABLE VIII-11
NSPS AND PSNS MODEL COSTS: BASIS 7/1/78 DOLLARS
BY-PRODUCT COKEMAKING
PAGE 2

	Effluent Quality$^{(6)}$	Raw Waste Level	NSPS and PSNS No.1 Effluent Level	NSPS AND PSNS No.2 Effluent Level
60	4,6-Dinitro-o-cresol	0.2	0.01	0.01
64	Pentachlorophenol	0.2	0.01	0.01
65	Phenol	200	0.01	0.01
(5)	Phthalates,total	20	0.20	0.06
72	Benzo(a)anthracene	0.3	0.01	0.01
73	Benzo(a)pyrene	0.1	0.02	0.01
76	Chrysene	0.4	0.05	0.01
77	Acenaphthylene	3	0.03	0.02
80	Fluorene	1	0.02	0.01
84	Pyrene	0.8	0.04	0.02
86	Toluene	35	0.05	0.05
114	Antimony	0.2	0.10	0.10
115	Arsenic	0.8	0.25	0.25
125	Selenium	0.2	0.10	0.10
126	Silver	0.1	0.06	0.05
128	Zinc	0.2	0.10	0.10
130	Xylene	25	0.02	0.01

---

(1) Treatment components are used in tandem.
(2) Costs are all power unless otherwise noted.
(3) Includes up to 115 gal/ton from air pollution control systems.
(4) All values are in mg/l unless otherwise noted.
(5) Sum of all phthalates - pollutants 66 through 71 (bis-2-ethylhexyl; butyl benzyl; di-n-butyl; di-n-octyl; diethyl; dimethyl phthalates).

KEY TO C&TT STEPS

A: 96% recycle of barometric condenser water
B: Fixed ammonia still including lime addition
C: Settling in a sedimentation basin
D: Neutralization with acid
E: Aeration (2 stage system)
F: Two-step activated sludge bio-oxidation unit
G: Vacuum filtration
H: Filtration
I: Powdered activated carbon addition

TABLE VIII-12

NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Beehive
: Cokemaking

Model Size-TPD : 1000
Operating Days/Year: 365
Turns/Day : 3

C&TT Step	1 A	1 B	Total
Investment $ x 10^{-3}	166	85	251
Annual Costs $ x 10^{-3}			
Capital	7.1	3.7	10.8
Depreciation	16.6	8.5	25.1
Operation & Maintenance	5.8	3.0	8.8
Sludge Disposal	7.2	-	7.2
Energy & Power (1)	-	6.2	6.2
TOTAL	36.7	21.4	58.1

Effluent Quality (2)	Raw Waste Load	Resulting Effluent Levels
Flow, gal/ton	300	0
Suspended solids	400	-
Ammonia (N)	0.35	-
Cyanide (Total)	0.004	-
Phenol (4AAP)	0.01	-
pH (Units)	6-9	-

---

(1) Costs are all power unless otherwise noted.
(2) All values in mg/l unless otherwise noted.

TABLE VIII-13

PSES MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: By-Product Cokemaking

Model Size-TPD : 3600
Oper. Days/Year: 365
Turns/Day : 3

C&TT Steps	Alt. 1										Alt. 2		Total (Incl A-H)
	A(1)	B(1)	C	D	E	F	G(1)	H(1)	I	Total	J(1)	I(1)	
Investment $ x 10^{-3}	225	4628	156	45	69	176	600	252	438	6589	52	438	6641
Annual Cost $ x 10^{-3}													
Capital	9.7	199.0	6.7	1.9	3.0	7.6	25.8	10.8	18.8	283.3	2.2	18.8	285.5
Depreciation	22.5	462.8	15.6	4.5	6.9	17.6	60.0	25.2	43.8	658.9	5.2	43.8	664.1
Operation & Maintenance	7.9	162.0	5.5	1.6	2.4	6.1	21.0	8.8	15.3	230.6	1.8	15.3	232.4
Sludge Disposal(2)	-	-	25.9	-	-	-	-	0.1	-	26.0	-	-	26.0
Energy & Power	2.5	2.5	1.2	1.2(4)	1.3	1.6	3.2	3.5	4.1	19.9	3.3	4.1	23.2
Chemical Costs	178.9	20.8	-	-	5.1	-	-	-	-	204.8	-	-	204.8
Steam Generation	-	520.3	-	-	-	-	-	-	-	520.3	-	-	520.3
Powdered Carbon	-	-	-	-	-	-	-	-	-	-	233.0	-	233.0
TOTAL	221.5	1367.4	54.9	8.0(4)	18.7	32.9	110.0	48.4	82.0	1943.8	245.5	82.0	2189.3

	Effluent Quality(3)	Raw(5) Waste Level	PSES No.1 Effluent Level	PSES No.2 Effluent Level
	Flow, gal/ton	168	153	153
	Suspended Solids	50	20	20
	Oil and Grease	75	5	5
	Ammonia (N)	600	15	15
	Phenols (4AAP)	300	0.025	0.025
	Cyanides (Total)	50	2.5	2.0
	Sulfide	150	0.4	0.3
	Thiocyanate	480	5	5
	pH (Units)	6-9	6-9	6-9
3	Acrylonitrile	1.2	0.03	0.01
4	Benzene	35	0.05	0.05
21	2,4,6-Trichlorophenol	0.1	0.01	0.01
22	Parachlorometacresol	0.6	0.01	0.01
23	Chloroform	0.2	0.10	0.05
34	2,4-Dimethylphenol	5	0.01	0.01
35	2,4-Dinitrotoluene	0.2	0.01	0.01
36	2,6-Dinitrotoluene	0.08	0.01	0.01
38	Ethylbenzene	3	0.02	0.01
39	Fluoranthene	0.8	0.02	0.01

TABLE VIII-13
PSES MODEL COST DATA: BASIS 7/1/78 DOLLARS
BY-PRODUCT COKEMAKING
PAGE 2

Effluent Quality[3]		Raw[5] Waste Level	PSES No.1 Effluent Level	PSES No.2 Effluent Level
54	Isophorone	0.5	0.02	0.01
55	Naphthalene	30	0.01	0.01
57	2-Nitrophenol	0.2	0.01	0.01
60	4-6,Dinitro-o-cresol	0.12	0.01	0.01
64	Pentachlorophenol	0.12	0.01	0.01
65	Phenol	275	0.01	0.01
(6)	Phthalates, Total	5	0.2	0.06
72	Benzo(a)anthracene	0.3	0.01	0.01
73	Benzo(a)pyrene	0.1	0.02	0.01
76	Chrysene	0.4	0.05	0.01
77	Acenaphthylene	3.5	0.03	0.01
80	Fluorene	0.6	0.02	0.01
84	Pyrene	0.6	0.04	0.01
86	Toluene	25	0.05	0.01
114	Antimony	0.2	0.10	0.10
115	Arsenic	2	0.25	0.25
125	Selenium	0.2	0.10	0.10
126	Silver	0.1	0.06	0.05
128	Zinc	0.2	0.10	0.10
130	Xylene	12	0.02	0.01

---

(1) Components are used in tandem.
(2) Costs are all power unless otherwise noted.
(3) All values are in mg/l unless otherwise noted.
(4) Total cost does not include power as a credit is supplied for existing process water needs.
(5) Quality of feed to system following free stills.
(6) Sum of all phthalates - pollutants 66 through 71 (bis-2-ethylhexyl; butyl benzyl; di-n-butyl; di-n-octyl; diethyl; dimethyl phthalates).

KEY TO C&TT STEPS

A: Lime addition to pH 10-12
B: Fixed ammonia stripping with lime
C: Settling Basin
D: 96% recycle of barometric condenser wastewaters
E: Neutralization with acid

F: Aeration (2 stages)
G: Bioxidation system (2 stages)
H: Vacuum filtration of bioxidation sludges
I: Filtration
J: Addition of powdered activated carbon

TABLE VIII-14

POLLUTANT LOAD REDUCTION SUMMARY
COKEMAKING SUBCATEGORIES

	Annual Pollutant Load (Tons/Year)				Percent Removal			
	Solids & Oils	Toxics	Others	Total	Solids & Oils	Toxics	Others	Total
A. By-Product Cokemaking Operations:								
Raw Waste Load	7,020	26,452	69,060	102,532	-	-	-	-
BPT Effluent	7,040	2,649	8,680	18,369	(0.3)	90.0	87.4	82.1
BAT 1/BCT Effluent	1,310	235	1,596	3,141	81.4*	91.1*	81.6*	82.9*
BAT 2 Effluent	1,310	137	1,177	2,624	81.4*	94.8*	86.4*	85.7*
BAT 3 Effluent	0	0	0	0	100.0*	100.0*	100.0*	100.0*
B. Beehive Cokemaking Operations:								
Raw Waste Load	200	<0.02	3.92	<204	-	-	-	-
BPT Effluent	0	0	0	0	100.0	100.0	100.0	100.0

---

*: Reductions from BPT effluent level.
(): Number in parentheses represents percent added during treatment.

TABLE VIII-15

ENERGY REQUIREMENTS SUMMARY
COKEMAKING SUBCATEGORY
BAT & BCT TREATMENT MODELS

	Model Basis		By-Product Total Basis(1)	
	kw/hr	Annual Cost	kw/hr	Annual Cost
BAT Alt. I/BCT Biological	29.7	6,500	1691.8	370,500
Physical/Chemical(2)	33.8	7,400	67.6	14,800
BAT 1/BCT Total	-	-	1759.4	385,300
BAT Alt. 2 Biological	44.7	9,800	2550.7	558,600
Physical/Chemical(3)	58.4	12,800	116.9	25,600
BAT Alt. 2 Total	-	-	2667.6	584,200
BAT Alt. 3 Biological	11.0	2,400	624.7	136,800
Physical/Chemical(4)	33.8	7,400	67.6	14,800
BAT Alt. 3 Total	-	-	692.3	151,600

---

(1) Data obtained by multiplying model basis by number of plants - 57 biological and 2 physical-chemical. Beehive operations are omitted, since energy requirements do not increase over BPT levels.
(2) Physical-chemical model replaces second stage biological treatment with adsorption on granular activated carbon.
(3) Physical-chemical model same as (2) plus addition of chlorination prior to adsorption.
(4) Physical-chemical model same as (2) plus evaporation to extinction at quench station.

NOTE: All values represent increases in addition to BPT energy requirements.

TABLE VIII-16

SOLID WASTES GENERATION SUMMARY
COKEMAKING SUBCATEGORY

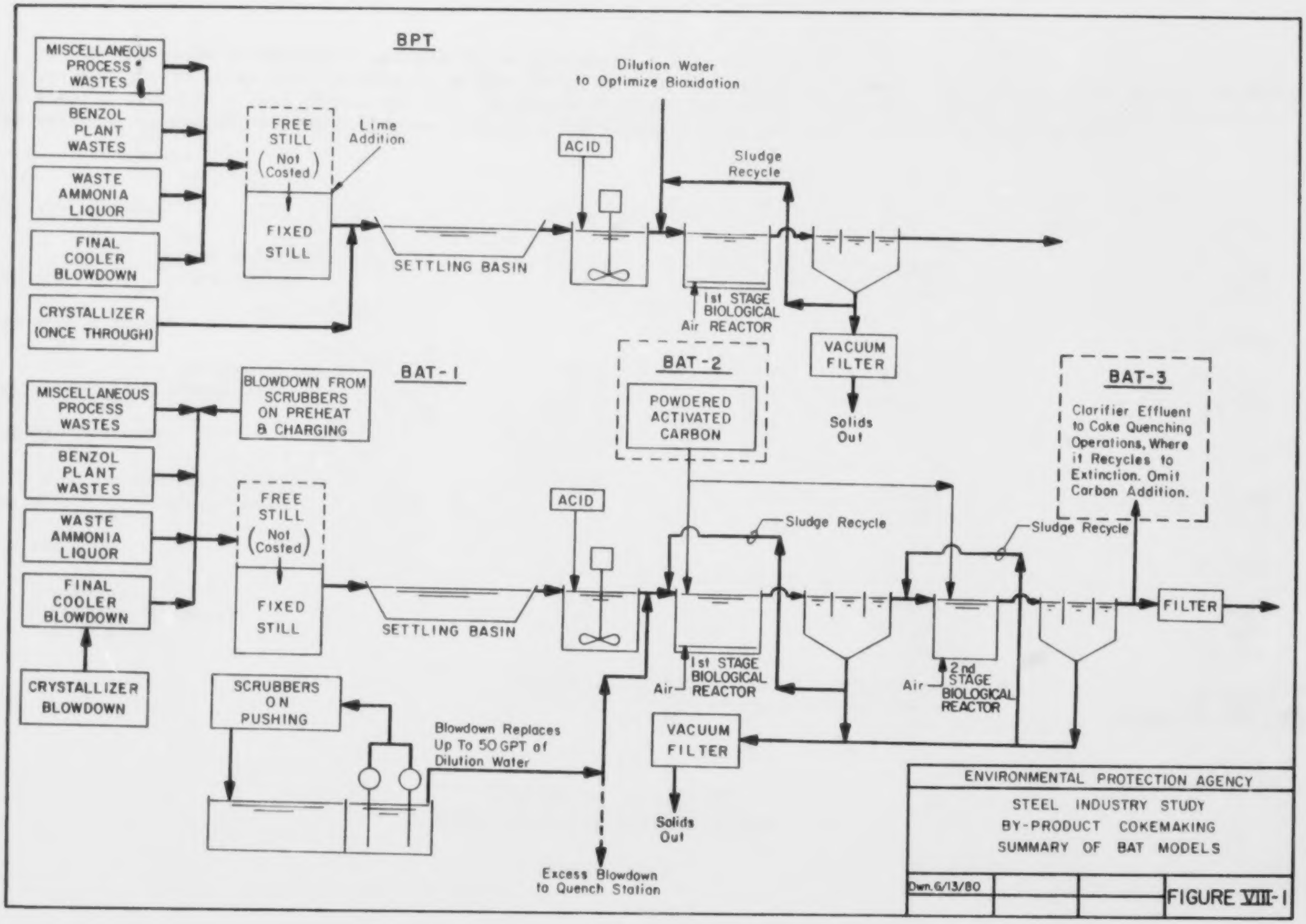
	Model Basis		Industry-Wide Basis(1
	Pounds/Ton of Coke	Pounds/Day	Tons/Year
BPT - Biological	6.2	22,320	232,184
- Physical/Chemical	6.0	21,600	7,884
- Beehive(2)	1.0	1,000	183
BPT Total	-	-	240,251
BAT Alt. 1(3) - Biological	0.05	180	1,872
- Physical/Chemical	0.28	1,000	365
BAT Alt. 1 Total	-	-	2,237
BAT Alt. 2(3) - Biological	0.30	1,080	11,235
- Physical/Chemical	0.28	1,000	365
BAT Alt. 2 Total	-	-	11,600
BAT Alt. 3 (3) - Biological	0.05	180	1,872
Physical/Chemical	0.28	1,000	365
BAT Alt. 3 Total	-	-	2,237

---

(1) Based on 57 biological and 2 physical/chemical treatment facilities, and 1 operating beehive plant.

(2) Beehive operations only appear for BPT since no additional solids are generated beyond this level of treatment.

(3) All BAT levels state the increase in solids loads as a result of BAT treatment. The stated value should be added to the BPT loads to determine the overall total load.


BPT
MISCELLANEOUS PROCESS* WASTES
BENZOL PLANT WASTES
WASTE AMMONIA LIQUOR
FINAL COOLER BLOWDOWN
CRYSTALLIZER (ONCE THROUGH)
FREE STILL (Not Costed)
FIXED STILL
Lime Addition
SETTLING BASIN
ACID
Dilution Water to Optimize Bioxidation
Sludge Recycle
1st STAGE BIOLOGICAL REACTOR
Air
VACUUM FILTER
Solids Out
BAT-1
MISCELLANEOUS PROCESS WASTES
BENZOL PLANT WASTES
WASTE AMMONIA LIQUOR
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
BLOWDOWN FROM SCRUBBERS ON PREHEAT & CHARGING
FREE STILL (Not Costed)
FIXED STILL
SETTLING BASIN
ACID
SCRUBBERS ON PUSHING
Blowdown Replaces Up To 50 GPT of Dilution Water
Excess Blowdown to Quench Station
BAT-2
POWDERED ACTIVATED CARBON
Sludge Recycle
Air
1st STAGE BIOLOGICAL REACTOR
VACUUM FILTER
Solids Out
Sludge Recycle
Air
2nd STAGE BIOLOGICAL REACTOR
BAT-3
Clarifier Effluent to Coke Quenching Operations, Where it Recycles to Extinction. Omit Carbon Addition.
FILTER
Dwn. 6/13/80

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKEMAKING
SUMMARY OF BAT MODELS

FIGURE VIII-1

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

The Best Practicable Control Technology Currently Available (BPT) limitations proposed herein are the same, for the most part, as those originally promulgated in June 1974. The June 1974 development document (EPA- 440/I-74-024-a; Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category) described in detail the methods used in developing the originally promulgated limitations.

Identification of BPT

Best Practicable Control Technology Currently Available (BPT) is generally based upon the average of the best existing performance by plants of various sizes, ages, and unit processes within the industrial subcategory, with particular emphasis on plants known to be equipped with well designed and operated treatment facilities.

Based on the information contained in Section III through VIII of this report, the Agency has determined that the Best Practicable Control Technology Currently Available (BPT) model technology for cokemaking incorporates the following steps:

A. For By-Product Cokemaking Operations

Blending of waste streams from benzol plants, final cooler blowdowns, and miscellaneous process wastes with excess ammonia liquor prior to passage through a free ammonia still. If a dephenolizer exists, it is inactive or abandoned. Treatment commences when the free still effluent is made alkaline (pH 9-11) with lime and stripped of fixed ammonia in the fixed leg of an ammonia still. Barometric condenser wastewaters from the crystallizer are combined with ammonia still effluents and detained in a storage tank, sedimentation basin or lagoon with a one day retention time. The basin effluent is treated with a small amount of acid, and passed on to an activated sludge basin with extensive aeration. The biotreated effluent is further treated in a clarifier, with vacuum filtration of underflows. The clarifier overflow is discharged to the receiving stream. This model treatment system is illustrated in Figure IX-1.

B. For Beehive Cokemaking Operations

The BPT model treatment system consists of equalization and settling of coke fines in a basin, with total recycle of the basin overflow to quenching operations. A periodic cleanout of the basin is necessary, and recovered solids are recycled to the ovens. Refer to Figure IX-2.

The proposed BPT effluent limitations resulting from this and previous studies are summarized in Table IX-1. The proposed BPT limitations are by no means the absolute lowest values attainable by the model technology at any time, but instead represent performance values which can be reasonably attained on a day by day basis. It should be noted that the Agency is not requiring that dischargers employ the model technology. Other systems can be employed as long as the proposed limitations are achieved. For example, the previously promulgated limitations could be achieved by both physical/chemical and biological methods.

It should be noted that the proposed limitations are 30-day average limitations. The maximum daily effluent limitations are three times the 30-day limitations. Total investment and annual costs associated with the installation of the BPT model treatment systems were provided in Table VIII-8.

Basis for BPT Limitations

The Agency reviewed the performance attained by the coke plants surveyed during this study, and these levels became the basis for establishing the proposed limitations. Significant changes were observed between plants surveyed in 1973 and those surveyed in 1977-78. During that time, more advanced treatment systems were installed, providing higher degrees of pollutant removal. At the same time, various approaches to air pollution emissions controls were employed, increasing wastewater volumes.

Because the number of choices available to coke producers is considerable, not only as to coke manufacturing and by-products recovery but also with respect to control and treatment of contaminated air and wastewater, the Agency employed a building block approach in determining the proposed limitations. The by-product cokemaking BPT effluent limitations promulgated in 1974 were based on a basic flow rate of 730 l/kkg (175 gal/ton), plus add-ons for indirect ammonia recovery and qualified desulfurizers. A review of additional data gathered since promulgation of the original BPT limitations indicate that this flow accurately reflects the average flow rates for by-product cokemaking operations at the BPT level of treatment.

The DCP responses for all active by-product cokemaking facilities indicates that 42% of all plants currently generate less than 175 gallons of process wastewaters per ton of coke produced, even when those portions of the total wastewater flows which are disposed of via quenching operations are included. Thus, the basic model flow of 175 gallons per ton used in establishing BPT limits is readily demonstrated by a large number of plants. The additional allowances provided in the proposed regulation for certain recovery operations are reviewed below.

The Agency believes that by-product coke plants which include indirect ammonia recovery systems (a total of six plants), should have an allowance for additional flow since they produce a more dilute weak ammonia liquor than is generated in semidirect recovery systems. Accordingly, an additional model wastewater flow of 209 l/kkg (50 gal/ton) is provided in the proposed BPT limitations. Likewise, for those plants which include wet desulfurizers, the Agency has proposed an allowance for additional flow resulting from contaminated condensates. However, not all desulfurizers qualify for these additional flows. Dry adsorption systems employing ferric oxide boxes, or extraction methods using solvents which do not increase wastewater volumes are not eligible for the additional allowance. However, the most common types of desulfurizer, those which scrub gases using a potash or soda ash slurry for adsorbing H_2S, then liberating the gases by distillation under a vacuum (the so-called vacuum carbonate processes) are eligible for an additional flow allowance of 104 l/kkg (25 gal/ton). This allowance includes the extra steam condensate and slurry associated with treatment of desulfurizer wastes in a fixed ammonia still.

The need for additional fresh water to optimize biological treatment systems was again reviewed by the Agency. Virtually all such plants practice water addition during at least part of the year. Even those plants which do not deliberately add fresh water usually have higher than normal process water flows entering the treatment system from some less aggressive source. For example, coal yard drainage and miscellaneous nonprocess waters from plant 008 were diverted through the bioxidation system, thus providing a dilution effect at least on an intermittent basis.

The Agency has yet to confirm the primary reasons why such water additions are necessary to optimize the effectiveness of bioxidation systems. Some operators relate water addition to contol of certain pollutants (e.g., ammonia, dissolved solids, cyanide) and practice it year-round. Of course, other means for controlling ammonia and cyanide exist. Still others add fresh water to control temperature and only practice dilution during certain seasons. Plant 003, has recently installed a non-evaporative cooling tower and provided insulation on its tanks to control wastewater temperature. This practice should eliminate the need for additional water. However, since the impact of this approach remains to be demonstrated, the proposed BPT limitations for biological treatment plants are based on a 28.6% higher basic flow rate of 938 l/kkg (225 gal/ton) to allow for fresh water addition to optimize treatment where necessary. The additional allowances for qualifying desulfurizers and indirect ammonia recovery systems also apply to biotreatment systems. Note also that biotreatment systems achieve lower concentrations of all proposed BPT limited pollutants except TSS, so loads remain unchanged even though a higher model flow has been used. The need for relaxing TSS limitations for bioxidation systems is apparent from the additional survey data obtained since promulgation of the original limitations. TSS is the only pollutant which has a proposed BPT limitation different from the previously promulgated limitations.

For beehive operations, no change in the proposed BPT limitations is necessary. The recommended technology and the no discharge condition have been demonstrated on a long-term basis.

Justification for Proposed BPT Limitations

A summary of effluent data from sampled plants is shown in Table IX-2. Data are reported for the total wastewater flows actually leaving the coke plant. In the case of Plant 009, the load shown includes a treated effluent which is disposed of by quenching, in addition to the direct discharge flow.

For each limited pollutant, most plants are shown to achieve the proposed BPT limitations. Where a pattern of noncompliance is noted, a simple explanation usually accounts for the failure of certain plants to meet limitations. For example, failure to meet limitations on ammonia-N results from the absence of fixed ammonia removal steps at Plants A, B, 002, 0584F-M and 0684F (quench). For cyanides, Plant A includes in its effluent an untreated barometric condenser flow containing excessive amounts of cyanides. For phenolic compounds, Plants C and 002 provide only minimal control, since discharges are routed to POTWs. When these exceptions are noted, most plants demonstrate the ability to meet the proposed limitations for each limited pollutant. The data shown in Table IX-2 justify the proposed BPT limitations.

TABLE IX-1

BPT EFFLUENT LIMITATION GUIDELINES
COKEMAKING SUBCATEGORY

	BPT Effluent Limitations in kg/kkg (lbs/1000 lbs)[1]						Estimated Cost[2]	
	TSS	O & G	NH_3-N	Cyanides	Phenolic Cpds.	pH (Units)	$/kkg	$/Ton
A. By-Product Cokemaking								
1. Basic Limitation	0.0750	0.0109	0.0912	0.0219	0.0015	6-9	1.50	1.36
2. Add for Indirect Ammonia Recovery	0.0167	0.0031	0.0261	0.0063	0.00042	6-9	0.33	0.30
3. Add for Wet Desulfurization	0.0083	0.0016	0.0131	0.0032	0.00021	6-9	0.17	0.15
B. Beehive Cokemaking								
1. Basic Limitations	No discharge of process wastewater pollutants to navigable waters.					-	0.18	0.16

---

(1) All values represent 30-day average limitations. Daily maximum limits are three times the load shown above.
(2) Costs represent BPT operating costs, including depreciation and capital use charges, assuming biological treatment systems are selected for by-product coke plants.

TABLE IX-2

BPT EFFLUENT LOAD JUSTIFICATION
COKEMAKING SUBCATEGORY

	Effluent Loads in kg/kkg (lbs/1000 lbs)					pH	Flow	
	TSS	O & G	NH_3-N	Cyanides	Phenolic Cpds.	(Units)	(Gal/Ton)	C&TT Components
I. By-Product Cokemaking								
Originally Promulgated BPT(1)	0.0365	0.0109	0.0912	0.0219	0.0015	6-9	175 P/C 225 Bio	NL;ASL;NA;SL-1 NL;ASL;SL-1;NA;A;BOA1;VF
Proposed BPT(2)	0.0750	0.0109	0.0912	0.0219	0.0015	6-9	225 Bio	NL;ASL;SL-1;NA;A;BOA1;VF
A. Plant Visit Data From Sampling Survey								
1. Biological Treatment Systems								
B (0112)	0.0734	0.00113	(0.431)(6)	0.00170	0.000029	7.5	108	E;BOA-1;QD(Part)
003 (0868A)(3)	0.0327	0.00335	0.000645	0.00196	0.000023	7.4	201	ASF;ASC;BOA-2;CL;SB;SS
008 (0920F)	0.0249	0.00464	0.0736	0.00142	0.000033	7.5-7.8	139	ASF;ASL;E;CT;BOA-2;CL
2. Other Treatment Systems								
A (0432B)(4)	0.00325	0.00221	(0.518)(6)	(0.0618)	0.000859	8.6	156	ASF;DP;SB(Part)
C (0384A)(4)	0.0173	0.00322	0.0657	0.0115	(0.0371)	(9.5-11.8)	40.6	ASF;DP;ASL;SB;QD(Part)
D (0272)	0.0645	0.00149	0.0137	0.0149	0.000616	(11.7)	28.8	ASF;DSN;DP;ASL
002 (0464C)(4)	0.00090	0.00599	(0.730)(6)	0.00243	(0.0126)	8.9-9.0	35.9	DP;CLA
009 (0684F)(3)(5)	0.0121	0.00363	0.0859	0.00907	0.000304	(8.8-9.9)	96.7	DP;GF;FDSP;ACC;ASF;ASC(Part); QT (Part)
B. Long-term Data Reported by Plants via D-DCP								
1. Biological Treatment Systems								
0012A	(0.163)	(0.0403)	0.0587	0.00436	0.00042	7.6	402	ASF;ASC;BOA-2;CL;QD(Part)
0584F-B	(0.137)	0.00408	(0.106)	0.00211	0.000073	7.7	287	ASF;ASC;BOA-2;CL
0584F-N	NR	NR	(0.306)(6)	NR	0.000243	6.7	208	ASF;BOA-2;CL
0868A(3)	NR	NR	0.0188	0.00129	0.0000295	7.4	210	ASF;ASL;E;CT;BOA-2;CL
2. Carbon Adsorption System								
0684F-Direct	0.0173	0.00231	(0.225)(6)	0.00984	0.0000765	(10.7)	99	DP;GF;FDSP;ACC;ASF;ASC
0684F-Quench	0.0103	0.00327	(0.164)(6)	0.0130	0.00000187	(9.3)	112	GF;FDSP;ACC;QT
0684F-Total	0.0276	0.00558	(0.389)(6)	(0.0228)	0.0000784	(9.3-10.7)	211	DP;GD;FDSP;ACC;ASF;ASC(Part); QT(Part)

TABLE IX-2
BPT EFFLUENT LOAD JUSTIFICATION
COKEMAKING SUBCATEGORY
PAGE 2

	Effluent Loads in kg/kkg (lbs/1000 lbs)					pH	Flow	
	TSS	O & G	NH_3-N	Cyanides	Phenolic Cpds.	(Units)	(Gal/Ton)	C&TT Components
II. **Beehive Cokemaking**								
Originally Promulgated BPT and Proposed BPT	No discharge of process wastewater pollutants to navigable waters							SL;RTP100
Plant Visit Data From Sampling Survey								
E	(0.0736)	(0.00041)	(0.00041)	(0.000008)	(0.000029)	(7.1)	490	SL;OT
F	No discharge of process wastewater pollutants to navigable waters						0	SL;RTP100
G	No discharge of process wastewater pollutants to navigable waters						0	SL;RTP100

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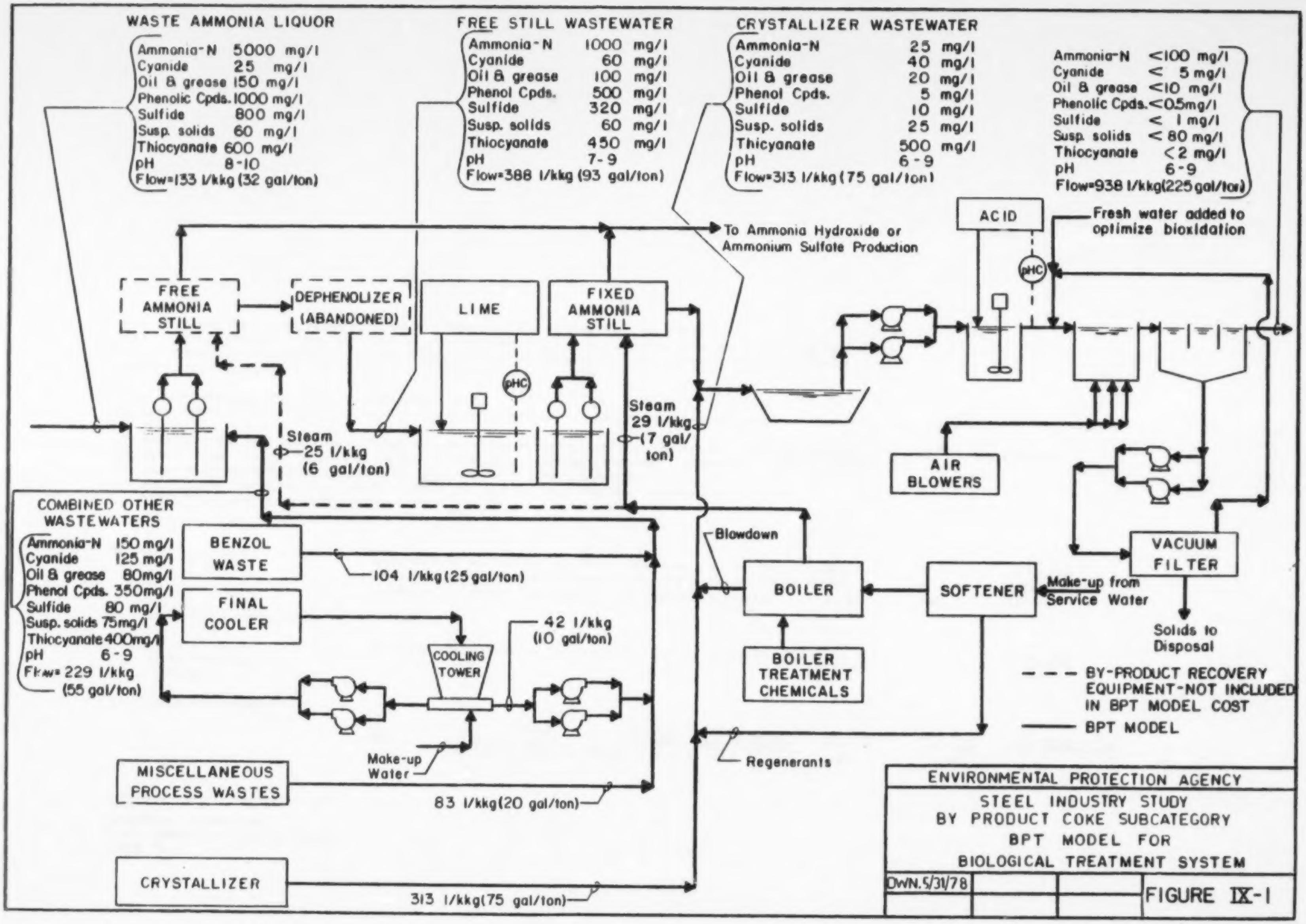
(1) Add 15% for qualified (wet) desulfurizers; add 30% for indirect ammonia recovery.
(2) Add 11% for qualified (wet) desulfurizers; add 22% for indirect ammonia recovery.
(3) Plant provides significantly more advanced treatment than BPT system.
(4) Plant discharges its treated wastewater to a POTW for further treatment. Phenol not treated on-site.
(5) Data includes load which is disposed of via quenching operations. Actual direct discharge effluent load is approximately half of the values given.
(6) High ammonia load in effluent primarily due to incomplete or ineffective ammonia stripping. Usually fixed ammonia removal step is inactive or non-existent.

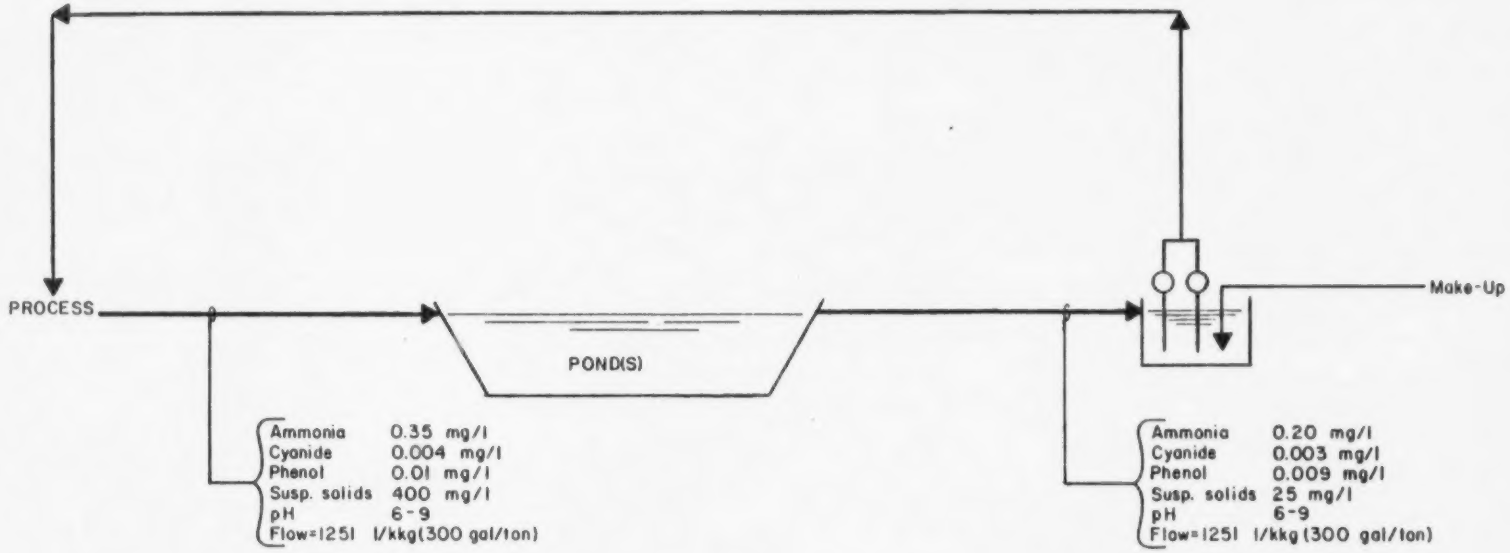
NOTES: For definitions of C&TT components, see Table VII-1.
Numbers in parentheses indicate nonachievement of the desired limitations for given parameter.
(Part) indicates that only part of the wastewater receives treatment from the given C&TT components.
NR indicates that plant provided no long-term data on the given parameter.


WASTE AMMONIA LIQUOR
Ammonia-N 5000 mg/l
Cyanide 25 mg/l
Oil & grease 150 mg/l
Phenolic Cpds. 1000 mg/l
Sulfide 800 mg/l
Susp. solids 60 mg/l
Thiocyanate 600 mg/l
pH 8-10
Flow=133 l/kkg (32 gal/ton)
FREE STILL WASTEWATER
Ammonia-N 1000 mg/l
Cyanide 60 mg/l
Oil & grease 100 mg/l
Phenol Cpds. 500 mg/l
Sulfide 320 mg/l
Susp. solids 60 mg/l
Thiocyanate 450 mg/l
pH 7-9
Flow=388 l/kkg (93 gal/ton)
CRYSTALLIZER WASTEWATER
Ammonia-N 25 mg/l
Cyanide 40 mg/l
Oil & grease 20 mg/l
Phenol Cpds. 5 mg/l
Sulfide 10 mg/l
Susp. solids 25 mg/l
Thicyanate 500 mg/l
pH 6-9
Flow=313 l/kkg (75 gal/ton)
Ammonia-N <100 mg/l
Cyanide < 5 mg/l
Oil & grease <10 mg/l
Phenolic Cpds. <0.5 mg/l
Sulfide < 1 mg/l
Susp. solids < 80 mg/l
Thiocyanate <2 mg/l
pH 6-9
Flow=938 l/kkg (225 gal/ton)
To Ammonia Hydroxide or Ammonium Sulfate Production
ACID
Fresh water added to optimize bioxidation
pHC
FREE AMMONIA STILL
DEPHENOLIZER (ABANDONED)
LIME
pHC
FIXED AMMONIA STILL
Steam 25 l/kkg (6 gal/ton)
Steam 29 l/kkg (7 gal/ton)
AIR BLOWERS
COMBINED OTHER WASTEWATERS
Ammonia-N 150 mg/l
Cyanide 125 mg/l
Oil & grease 80 mg/l
Phenol Cpds. 350 mg/l
Sulfide 80 mg/l
Susp. solids 75 mg/l
Thiocyanate 400 mg/l
pH 6-9
Flow= 229 l/kkg (55 gal/ton)
BENZOL WASTE
104 l/kkg (25 gal/ton)
FINAL COOLER
COOLING TOWER
42 l/kkg (10 gal/ton)
Make-up Water
MISCELLANEOUS PROCESS WASTES
83 l/kkg (20 gal/ton)
CRYSTALLIZER
313 l/kkg (75 gal/ton)
Blowdown
BOILER
BOILER TREATMENT CHEMICALS
SOFTENER
Make-up from Service Water
Regenerants
VACUUM FILTER
Solids to Disposal
— — — BY-PRODUCT RECOVERY EQUIPMENT-NOT INCLUDED IN BPT MODEL COST
—— BPT MODEL
DWN. 5/31/78

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY PRODUCT COKE SUBCATEGORY
BPT MODEL FOR
BIOLOGICAL TREATMENT SYSTEM

FIGURE IX-1


PROCESS
POND(S)
Make-Up
Ammonia 0.35 mg/l
Cyanide 0.004 mg/l
Phenol 0.01 mg/l
Susp. solids 400 mg/l
pH 6-9
Flow=1251 l/kkg(300 gal/ton)
Ammonia 0.20 mg/l
Cyanide 0.003 mg/l
Phenol 0.009 mg/l
Susp. solids 25 mg/l
pH 6-9
Flow=1251 l/kkg (300 gal/ton)

—— BPT MODEL

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
COKEMAKING-BEEHIVE OPERATION
BPT MODEL

DWN.5-25-78

FIGURE IX -2

COKEMAKING SUBCATEGORY

SECTION X

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

The effluent limitations to be achieved by July 1, 1984 are to specify the degree of effluent load reduction attainable through the application of the Best Available Technology Economically Achievable (BAT). BAT is to be determined by identifying the very best control and treatment technology employed within the industrial subcategory, or where it is readily transferable from one industry to another, such technology may be identified as BAT. This section describes three alternatives for by-product cokemaking, and identifies the alternative selected by the Agency as the basis for proposed BAT limitations. For beehive operations, BAT is identical with the proposed BPT limitations described in Section IX.

As indicated in Section V, significant changes in air emission controls and wastewater control and treatment technology have produced several treatment options for by-product cokemaking operations. Because of the number of choices available, the Agency decided to use a building block approach in developing the proposed BAT limitations as it did with the proposed BPT limitations. Flow rates from certain wastewater sources can be minimized by recycling or reuse where appropriate, or by process changes which eliminate wastewater sources such as replacing barometric condensers with surface condensers. However, an approach proposed in the original development document EPA-440/1-74-024a (recycling barometric condenser wastewaters to achieve a 72 gal/ton flow reduction from that source alone) is applicable to only 14 of the 59 plants responding to EPA questionnaires and is currently practiced by seven plants, which have an average condenser blowdown flow of 5.2 gal/ton. The remaining plants have no wastewaters from this source.

Although wastewater disposal by coke quenching is widely practiced, more stringent air pollution control requirements mitigate against continued widespread use of this practice. Such wastewaters will have to be treated in existing or expanded treatment facilities, then discharged to surface waters. Also, the large volumes of water used in scrubbers associated with control of atmospheric emissions from oven charging and pushing require control and treatment. Recycle of the scrubber waters can be used to minimize the volume requiring treatment. However the blowdowns from these systems must be treated prior to discharge.

Model BAT Flow

The flows of the model treatment system for by-product cokemaking operations are based on values shown in Table X-1. Plants which demonstrate or closely approach the BAT model flow for each wastewater source are listed in Table X-2.

The proposed limitations include an allowance for additional process wastewater flow for those plants practicing indirect ammonia recovery. These six plants produce about 6% of the annual coke tonnage. They qualify for supplemental load allowances based on 209 l/kkg (50 gal/ton) flow rates. The desulfurizer allowances listed in Section IX are also included in the proposed BAT limitations.

The Agency considered providing an allowance for fresh water dilution to optimize biological treatment. However dilution with fresh water is replaced at the BAT level of treatment with other flows collected for joint treatment, notably pushing emission control blowdowns. The impact of extremes in temperature can be eliminated by installing indirect cooling systems or by allowing sufficient retention and equalization time prior to biological treatment. Providing suitable pretreatment and equalization of the ammonia liquor prior to biological treatment also minimizes the amount of "dilution" which is necessary to protect the microorganisms. Where sufficient wastewater volumes from other less aggressive sources exist, they should replace all or part of the 50 gal/ton dilution which was included in the proposed BPT limitations.

The model wastewater discharge flows used as a basis for BAT cost estimates are as summarized in Table X-1. The pollutant levels which the BAT alternative treatment system can achieve are discussed below on a pollutant-by-pollutant basis. The alternative systems were described in Table VIII-4 and schematics of the three alternative BAT treatment models are shown in Figure VIII-1. The proposed BAT limitations are set out in Table X-3 (Alternative No. 1).

Identification of BAT Alternatives

The three BAT alternative treatment systems for by-product cokemaking operations are as follows.

A. BAT Alternative 1

The first step is the recycle of crystallizer wastewaters, if any, to minimize the flow to be treated. That step is followed by a second stage or extended biological system. For costing purposes a second stage biological system, complete with its own clarifier was included. A final treatment step of filtration is provided to prevent carryover of suspended matter and any toxic pollutants that may be included in the suspended solids. This system is diagrammed as Alternative 1 in Figure X-1. Individual component costs are shown in columns H through K of Table VIII-9. Annual costs over and above the costs of the BPT model treatment system are estimated at $0.12/ton of coke.

B. BAT Alternative 2

Alternative 1 can be upgraded to provide better control of toxic organic pollutants and ammonia removal by the addition of powdered activated carbon to the biological reactors. Refer to Figure X-2 for a diagram of the system. Limited data indicate that single stage systems, with or without powdered activated carbon can produce comparable effluent quality. However, the system performance has not fully been assessed.

C. BAT Alternative 3

The treated effluent from either of the above biological alternative systems may be disposed of by coke quenching where impacts on air pollution can be tolerated. Although this approach cannot be recommended universally, it provides a means of achieving zero discharge. Refer to Figure X-3 for a diagram, and to Table VIII-9, columns H, I, J, and M for cost information.

Selection of a BAT Alternative

The Agency selected BAT Alternative No. 1 as the BAT model treatment system upon which the proposed BAT limitations are based. This technology is practiced in this subcategory on a full-scale basis. The two-step or extended biological oxidation system is currently installed at four by-product coke plants, while filtration of biological treatment system discharges is practiced at Plant 0856A. BAT Alternative No. 2, which provides for the addition of powdered activated carbon, has been limited to short-term testing on a semi-pilot scale, and shows promise of only a marginal reduction in total pollutant loads. Alternative 3 cannot be applied in most cases because of its impact on air pollution.

Currently, two plants are operating advanced physical/chemical wastewater treatment systems which incorporate technologies other than bioxidation. Both of these plants, 0684F (009) and 0732A (001) provide mixed media pressure filtration and granular activated carbon adsorption using fixed bed columns, while the latter plant also is equipped with alkaline chlorination. The Agency has decided to propose separate BAT limitations for these plants, and for any others which may have installed full scale granular activated carbon columns by the time these limitations are proposed. These limitations are similar to the proposed BAT limitations for all other by-product cokemaking plants, except for ammonia-N, phenolic compounds and total cyanide. Refer to Table X-3 for details on physical/chemical BAT effluent limitations. The proposed limitations can be achieved by treatment systems consisting of flow minimization (as in BAT Alternative No. 1 above), fixed ammonia stripping, followed by pressure filtration and adsorption on fixed beds of granular activated carbon. Initial capital investments for this addition to the BPT system are 2.5 times the biological alternative, while operating costs over and above the BPT level (physical/chemical treatment) are several times that of the selected biological alternative.

Impact of BAT Technologies on Toxic Pollutants

Table VIII-9 includes effluent quality data for each BAT alternative technology. The Agency evaluated the impact of BAT model treatment system components on toxic pollutants using data obtained during sampling surveys at Plants 003, 008, 009, together with long-term and special verification pilot scale study data from Plants 003 and 001, respectively. The treatment system at Plant 001 has only been recently installed, so long-term data are not yet available. Plant 003 most nearly represents biological Alternative 1, while Plant 001 and 009 are the two physical/chemical treatment systems. Sufficient analytical data are available to determine treatment system impacts on toxic pollutants (Table X-4).

Note that most of the toxic pollutants are controlled to low levels by either treatment system. The critical treatment step in each alternative is obvious - carbon adsorption for the physical/chemical system, and biological oxidation for the biological system.

Control and Treatment of Pollutants Using BAT Technology

As discussed in Section VII and summarized in Table VII-3, the many toxic organic pollutants identified in wastewaters from by-product cokemaking can be controlled by treating those pollutants listed in the proposed BPT limitations, plus benzene, naphthalene, and benzo(a)pyrene. The Agency selected these latter three toxic organic pollutants, together with the previously limited phenolic compounds (4-AAP method) to serve as indicators for volatile, acid, and base/neutral compounds. For discussion of the treatability of TSS and oil and grease with the BAT model treatment systems refer to Section XI. The other pollutants included in the proposed BAT limitations are present at levels shown in Table IX-2. A discussion of the reductions achieved by the BAT model treatment system on a pollutant by pollutant basis follows.

Ammonia-N

Of the plants identified in Section IX as achieving the proposed BPT limit for ammonia-N, Plant 003 is able to achieve the proposed BAT limitations for ammonia-N using biological treatment. During the toxic pollutant survey, Plant 003 discharged 0.77 mg/l ammonia-N in a flow of 201 gal/ton, equivalent to less than 10% of the proposed BAT limit. Year-round data provided for the plant show daily ammonia-N loads which comply with the proposed limitations consistently. From April, 1979 through May, 1980 all monthly average values were within the 30-day average BAT limitation. Daily maximum values were exceeded for only 4 consecutive days in a sixteen month period. These observations were confirmed during seven weeks of EPA verification sampling on-site between October, 1979 and February, 1980. Daily maximum levels never exceeded 64% of the proposed BAT limitation, and monthly averages for October, January, and February were at <1, 43, and 75% of BAT 30-day average values, respectively. Routine daily analyses reported by the company covering the same period indicate the same high degree of compliance. This successful ammonia-N load reduction is achieved by passing all wastewaters through free and fixed stills, an aerated sludge lagoon with two separate compartments, and a clarifier. The ammonia stills reduce ammonia levels from 2,400 mg/l in the raw liquor to 60 mg/l in the combined feed to biological treatment. The ammonia content is further reduced by the later treatment.

The remaining plants with the proposed BPT model treatment system failed to achieve the proposed BAT limitations on ammonia-N for differing reasons. Plant C discharges to a POTW, and no other treatment for ammonia removal is provided except the free and fixed stills. Plant 008 uses a treatment sequence similar to Plant 003, but does not subject its benzol plant wastewaters to ammonia stripping. Although the ammonia liquor has only 33 mg/l of ammonia-N after stripping, the addition of raw benzol plant wastewaters raises the ammonia concentration to 202 mg/l. Biotreatment reduces ammonia content to 127 mg/l in the effluent. If this rate of reduction were applied to the stripped liquor concentration of 33 mg/l, about 21 mg/l of ammonia-N would remain in the effluent. The lower ammonia content of the feed to biotreatment would also tend to improve further reduction and thus approach compliance. Also, at the time during which Plant 008 was sampled (Sept. 6-9, 1977) only one of the two aeration basins was in use. Since then, the second basin has been placed in operation.

Plant 003 demonstrates the ability of biological treatment facilities to attain the proposed BAT limitation for ammonia-N. Sampling data from physical/chemical Plant 009 indicates an ammonia discharge of 3.3 times the applicable proposed BAT limitation, at 0.0859 kg/kkg. This includes a portion of the treated wastewater which is currently evaporated in quenching operations. The actual ammonia load being discharged directly is 0.0568 kg/kkg, which exceeds the proposed BAT limitations for physical/chemical treatment systems by 120%. Although the treatment system is designed to strip fixed ammonia following caustic addition, data (toxic survey and long-term) indicate that this reaction is not carried to completion. During EPA's sampling visit, ammonia concentration was reduced from 7750 mg/l to 290 mg/l in the still, but pH values never exceeded 9.0 in the still effluent, indicating that the 290 mg/l could have been further reduced. Long-term data reported by the plant covering the period from July, 1977 through June, 1978 are in the form of ranges and averages only. (During and after this period, the company was modifying its pH control system and installing a dephlegmator on the ammonia still). Ammonia concentrations in the still effluent average 544 mg/l but the range was 9.9 mg/l to 8450 mg/l. The pH levels went from 7.6 to 13.6 with a median near 10.7. Even though the median pH was reasonably high, the fact that pHs were permitted to remain as low as 7.6 in some cases greatly influenced the average ammonia value. Even a few instances where stripping failed to recover fixed ammonia causes the long-term average to far exceed limitations. For example, if the reported maximum value (8450 mg/l) is omitted from the calculation of the average, the recalculated average becomes 389 mg/l, a 28.5% reduction of the overall average. This plant could attain the proposed BAT limitation for physical/chemical plants for ammonia by improving fixed ammonia removal efficiency and maintaining an ammonia still effluent quality of 80-100 mg/l if only current direct discharge wastewaters are stripped, and of 40-50 mg/l if all wastewaters are discharged directly in the future. Either of these levels are attainable by well designed and well operated modern stills.

Total Cyanide

Of the plants achieving the proposed BPT limitations for total cyanide, two of the biological treatment systems approach or achieve the proposed BAT limitations as well. Plant 003 exceeded the proposed limitations by 23% during short-term surveys, but data provided by the company indicates that it has complied with the proposed limitations on a long-term basis. Daily analyses for the period November, 1977 through July 1980 demonstrate compliance, averaging 2.0 mg/l on a year-round basis. Most of the noncompliance daily maxima occurred during the start-up of the system. For the 33 months for which daily analyses are available, only four monthly averages exceeded the 30-day average limitation, and daily maximum limits were exceeded only 9 times out of 1002 days, usually by slim margins. This high level of compliance persisted throughout the seven week EPA verification survey during the period of October, 1979 through February, 1980. Overall average total cyanide loads were at 76% of the 30-day average limitations and only one value out of 21 daily values exceeded the daily maximum limit.

Plant 008 was within compliance during the EPA toxic pollutant survey, and long-term data covering ten months of operations (but only six months of analytical tests for total cyanides), demonstrated compliance with the 30-day average limitation for all months reported. All daily loads met the proposed BAT limitation for daily maximum values. These two plants serve to demonstrate the effectiveness of the model treatment system in reducing total cyanide loads to the proposed BAT limitations.

Phenolic Compounds

Data obtained during the sampling surveys demonstrate the achievability of the proposed maximum daily BAT limitation for phenolic compounds. All three of the biological treatment plants were discharging less than 50% of the BAT daily maximum limitations. Moreover, long-term data covering 33 months of operation at Plant 003 demonstrate consistent attainment of the proposed 30-day average limitation. During that period, the overall average of all monthly averages was 67% of the 30-day average limitation. Of the 33 months, only three exceeded the stated limits, none within the past two years. The proposed daily maximum limitation has been exceeded only three times within the past two years, by a maximum of 36%.

The primary treatment system component in the physical/chemical systems is activated carbon adsorption. Phenolics in the wastewaters flowing into the two separate carbon systems at Plant 009 were effectively reduced on contact with activated carbon. Ammonia liquor at 90 mg/l of phenolics was reduced to 0.058 mg/l, while benzol plant wastes at 1,550 mg/l of phenolics were reduced to 0.168 mg/l by contact with carbon during the toxic pollutant survey. Long-term data from the same plant show effluent loads of 0.0000765 kg/kkg discharged directly and <0.000002 kg/kkg disposed of by quenching. Direct discharge data are based on 50 analyses.

Benzene

The toxic pollutant plant sampling visits and the verification program at Plant 003 are the primary sources of data for benzene (refer to Table VII-3 for data for toxic organics). Short-term results indicated that Plant 009 achieves the proposed BAT limitations for benzene by carbon adsorption, and Plant 003 achieves such limits by biological treatment. Evaluation is complicated due to the small concentrations present, which were reported as averaging less than 0.06 mg/l in treated effluents. For Plant 003, this is equivalent to <0.00005 kg/kkg compared with a proposed BAT limitation of 0.000032 kg/kkg. Analytical data from the seven week (21 sampling days) verification sampling done at Plant 003 indicate that the proposed BAT limitations for benzene were consistently achieved. Monthly averages never exceeded 30% of the proposed BAT limit, while daily loads never exceeded 22% of the daily maximum load. Also, pilot plant data from Plant 001 indicate that their physical/chemical treatment system will adsorb benzene on carbon so effectively that effluents from the carbon columns will average <0.03 mg/l consistently. This approaches the performance of Plant 009's full-scale system, whose effluent shows <0.01 mg/l of benzene.

Naphthalene

Three of the four plants surveyed for toxic pollutants demonstrate an ability to control naphthalene to less than 0.000006 kg/kkg. Biological systems at Plants 003 and 008 attain "none detected" and <0.000002 kg/kkg respectively, and carbon adsorption plant 009 matches this latter figure.

Pilot scale data from plant 001 (physical/chemical) show carbon column effluents at <0.01 mg/l, often at "none detected" and verification data from Plant 003 shows only one daily value out of 21 which exceeded the proposed daily maximum BAT limitation for naphthalene. Based on these data, the Agency believes that the proposed BAT limitation can be achieved using the BAT model treatment system as well as by using the advanced physical/chemical treatment systems.

Benzo(a)pyrene

All four of the plants surveyed for toxic organic pollutants attain the proposed BAT limitation for benzo(a)pyrene of 0.000013 kg/kkg. The two biological oxidation plants 003 and 008 discharged 0.000011 kg/kkg and "none detected" respectively. The carbon adsorption system at Plant 009 also complies with the proposed benzo(a)pyrene limit by treating to <0.00001 kg/kkg.

Pilot plant data for the activated carbon system at Plant 001 showed <0.01 mg/l or "none detected," while verification data from Plant 003 was consistently below the proposed daily maximum limitation except for a three-day outage in January, 1980 where maxima were exceeded by 365, 4, and 19%. Pilot filtration data indicate this outage was due to benzo(a)pyrene which had been adsorbed on activated sludges, and was carried out with abnormally high concentrations of TSS (500-1400 mg/l). Hence, the importance of post filtration of the BAT Alternative No. 1 effluent is demonstrated in achieving the proposed limitations for toxic organic pollutants.

TABLE X-1

FLOW SUMMARY
BY-PRODUCT COKEMAKING SUBCATEGORY

(All Flows in Gallons/Ton of Coke)

	Flow Basis	
Wastewater Source	BAT Feed	BAT Effluent
Waste Ammonia Liquor	32	32
Final Cooler Blowdowns	10	10
Barometric Condenser Discharge	75	3
Benzol Plant Wastewaters	25	25
Steam & Lime Slurry	13	13
Miscellaneous Sources (leaks, seals, test taps, drains)	20	20
Dilution to optimize bio-oxidation	50	50*
BASIC TOTAL FLOW	225	153
Additional Flow Allowances Provided in the Regulation:		
For Qualified Desulfurizers (Wet)	25	25
For Indirect Ammonia Recovery	50	50
No Additional Allowances For:		
Air Pollution Control Scrubbers:		
Coal Drying or Preheating - up to 15 GPT Blowdown*	0	0
Charging/Larry Car - up to 5 GPT Blowdown*	0	0
Pushing Side Scrubber - up to 100 GPT Blowdown*	0	0
MAXIMUM TOTAL FLOW	300	228

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*: Up to 50 GPT of dilution water is replaced by blowdowns from air pollution control scrubbers. Any excess blowdown (from pushing only) is disposed of via quenching operations, or treated and reused in the scrubber system.

TABLE X-2

BAT EFFLUENT FLOW JUSTIFICATION BY-PRODUCT COKEMAKING

Wastewater Source	BAT Effluent Flow Basis in GPT	Plants Which Demonstrate BAT Flow			
		Code No.	GPT	Code No.	GPT
Waste Ammonia Liquor	32	0256E	15	0684I	27
		0948A	17	0584C	28
		0684J	20	0868A	28
		0060F	21	0348A	29
		0684H	22	0112B	31
		0112C	24	0280B	31
		0112D	25	0684F	32
		0212	25	0732A	32
		0112	26	0112A	33
		0584F	27	0860B	33
Final Cooler Blowdown	10	0448A	<1	0320	6.2
		0856F	1.2	0584C	8.3
		0684A	2.6	0684B	11.3
		0112C	6.0		
Barometric Condenser Blowdown(1)	3(4%)	0448A	<1(<1%)	0112D	6.7(2.6%)
		0856F	2.4(<1%)		
Benzol Plant Wastewaters	25	0584F	15.6	0948A	25.2
		0448A	15.9	0112C	25.3
		0856N	24.3	0864A	30.7
Steam and Lime Slurry(2)	13	0384A	8.0	0920F	11.6
		0868A	11.0	0272	13.1
Miscellaneous Sources	20	0112	21.0	0868A	21.1
Bioxidation Optimization	50	0584F-BI	50.8	0584F-M	55.0
Wet Desulfurization	25	0112D	22.2		
Indirect Ammonia Recovery(3)	50 (added to basic 32 above=82)	0810	36	0402	76
		0464E	55	0024A	79
		0948C	59	0464B	82

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(1) Numbers in parentheses represent % of applied rate going to blowdown.

(2) Includes steam from free and fixed ammonia stripping, plus water used to make lime slurry or caustic solutions. Even though free ammonia removal is considered to be a recovery process and not pollution control, the steam condensates must be included among the wastewaters requiring treatment.

(3) Plants which practice indirect ammonia recovery qualify for 50 additional GPT ammonia liquor allownace over and above the 32 GPT which all plants receive.

TABLE X-3

BAT EFFLUENT LIMITATION GUIDELINES
COKEMAKING SUBCATEGORY

	BAT Effluent Limitations in kg/kkg (lbs/1000 lbs)(1)					
	NH3-N	Cyanides(2)	Phenolic Compounds(3)	Benzene(4)	Naphthalene(4)	Benzo(a)pyrene(4)
A. By-Product Cokemaking Alternative 1*						
1. Basic Limitation	0.00957 0.0258(5)	0.00160 -(5)	0.000016 0.000022(5)	0.000032 0.000022(5)	0.000006 0.000004(5)	0.000013 0.000009(5)
2. Add for Indirect Ammonia Recovery	0.00313 0.0125(5)	0.000521 -(5)	0.000005 0.000010(5)	0.000010	0.000002	0.000004
3. Add for Wet Desulfurization	0.00156 0.00626(5)	0.000261 -(5)	0.000003 0.000005(5)	0.000005	0.000001	0.000002
B. By-Product Cokemaking Alternative 2						
1. Basic Limitation	0.00957 0.0258(5)	0.00128 -(5)	0.000016 0.000022(5)	0.000032 0.000022(5)	0.000006 0.000004(5)	0.000006 0.00004(5)
2. Add for Indirect Ammonia Recovery	0.00313 0.0125(5)	0.000417 -(5)	0.000005 0.000010(5)	0.000010	0.000002	0.000002
3. Add for Wet Desulfurization	0.00156 0.00626(5)	0.000209 -(5)	0.000003 0.000005(5)	0.000005	0.000001	0.000001
C. By-Product Cokemaking Alternative 3						
1. Basic Limitations 2. Add for Indirect Ammonia Recovery 3. Add for Wet Desulfurization	No Discharge of Process Wastewater Pollutants to Navigable Streams					
D. Beehive Cokemaking	No Discharge of Process Wastewater Pollutants to Navigable Streams (Same as BPT)					

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(1) 30-Day average BAT limitations. Daily maximum values are twice the limitations stated for cyanides, benzene, NH$_3$-N (Physical-chemical systems), naphthalene and benzo(a)pyrene; four times the stated limit for phenolic compounds; and 5.34 times the limit for NH$_3$-N (biological systems).
(2) Total Cyanides. Note that no limitation applies to physical-chemical systems.
(3) Using 4-AAP test method.
(4) Using GC/MS test method. Except for basic limitation, additions are the same for biological and physical-chemical systems.
(5) Limitation for physical-chemical treatment systems.
* : Selected BAT Alternative

TABLE X-4

IMPACT OF SELECTED BAT TECHNOLOGIES ON TOXIC POLLUTANTS

All concentrations in micrograms/liter.

Pollutant	Physical-Chemical Alternative				Biological Alternative			
	BAT Feed	Gas Flot.	Filtration	Carbon Ads.	BAT Feed	Bio-treatment	Clarifier	Filtration
Organics:								
Acenaphthene	20	15	7	5	50	10	2	2
Acenaphthylene	2,750	2,750	2,400	5	6,000	10	5	5
Acroylonitrile	750	550	400	200	10,000	ND	ND	ND
Benzene	40,000	40,000	40,000	10	10,000	250	25	20
Benzo(a)anthracene	500	400	250	5	1,000	25	2	2
Benzo(a)pyrene	400	400	300	10	100	15	10	<10
Chloroform	10	10	20	20	1,250	200	200	100
Chrysene	750	200	200	5	1,250	10	10	10
2,4-Dimethylphenol	25	35	35	ND	4,000	ND	ND	ND
Ethylbenzene	25,000	25,000	200	10	200	10	2	2
Fluoranthene	1,500	1,000	750	10	300	10	2	2
Fluorene	700	600	500	5	75	10	2	2
Naphthalene	35,000	25,000	20,000	5	2,000	10	2	2
2-Nitrophenol	40	30	30	5	ND	ND	ND	ND
Pentachlorophenol	750	500	400	5	ND	ND	ND	ND
Phenol	80,000	35,000	30,000	25	75,000	40	15	10
Pyrene	1,750	1,750	750	7	100	25	10	10
Toluene	30,000	25,000	20,000	7	4,000	75	40	40
Xylene	200,000	200,000	150,000	5	ND	ND	ND	ND

TABLE X-4
IMPACT OF SELECTED BAT TECHNOLOGIES ON TOXIC POLLUTANTS
PAGE 2

	Physical-Chemical Alternative				Biological Alternative			
Pollutant	BAT Feed	Gas Flot.	Filtration	Carbon Ads.	BAT Feed	Bio-treatment	Clarifier	Filtration
Nonorganics:								
Antimony	400	400	300	200	150	150	125	50
Arsenic	200	160	150	100	500	400	250	70
Beryllium	*	*	*	*	10	2	2	2
Cadmium	10	10	10	10	15	10	10	<10
Chromium	ND	ND	ND	ND	25	20	10	<10
Copper	50	25	25	20	25	20	20	<10
Cyanide	30,000	25,000	25,000	25,000	15,000	2,500	2,000	2,000
Lead	50	50	50	50	100	40	25	20
Mercury	0.8	0.8	0.8	0.8	0.8	0.3	0.1	0.1
Nickel	ND	ND	ND	ND	50	25	10	<10
Selenium	75	60	55	40	300	150	100	80
Silver	20	20	20	20	100	25	10	<10
Zinc	ND	ND	ND	ND	200	100	80	50

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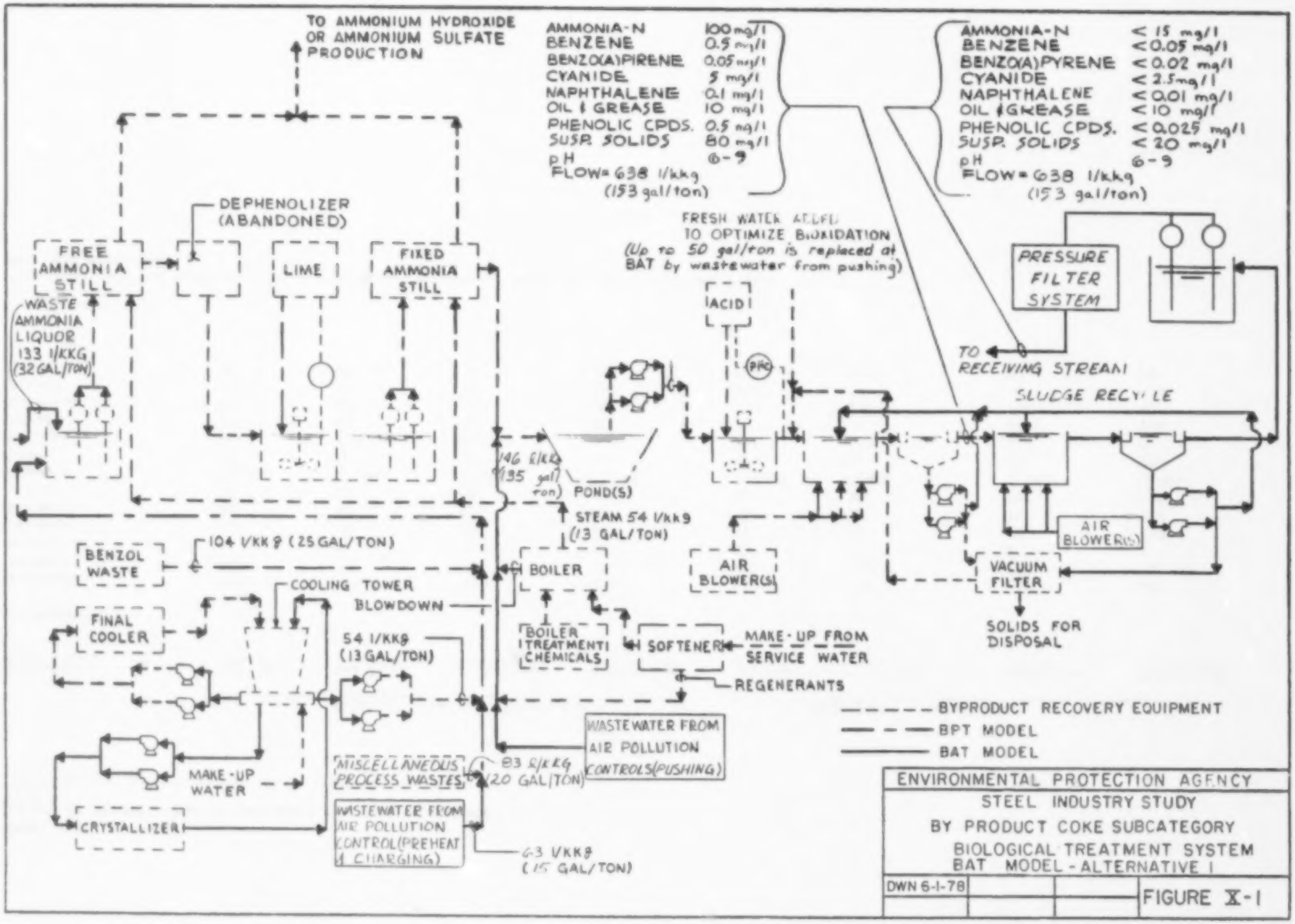
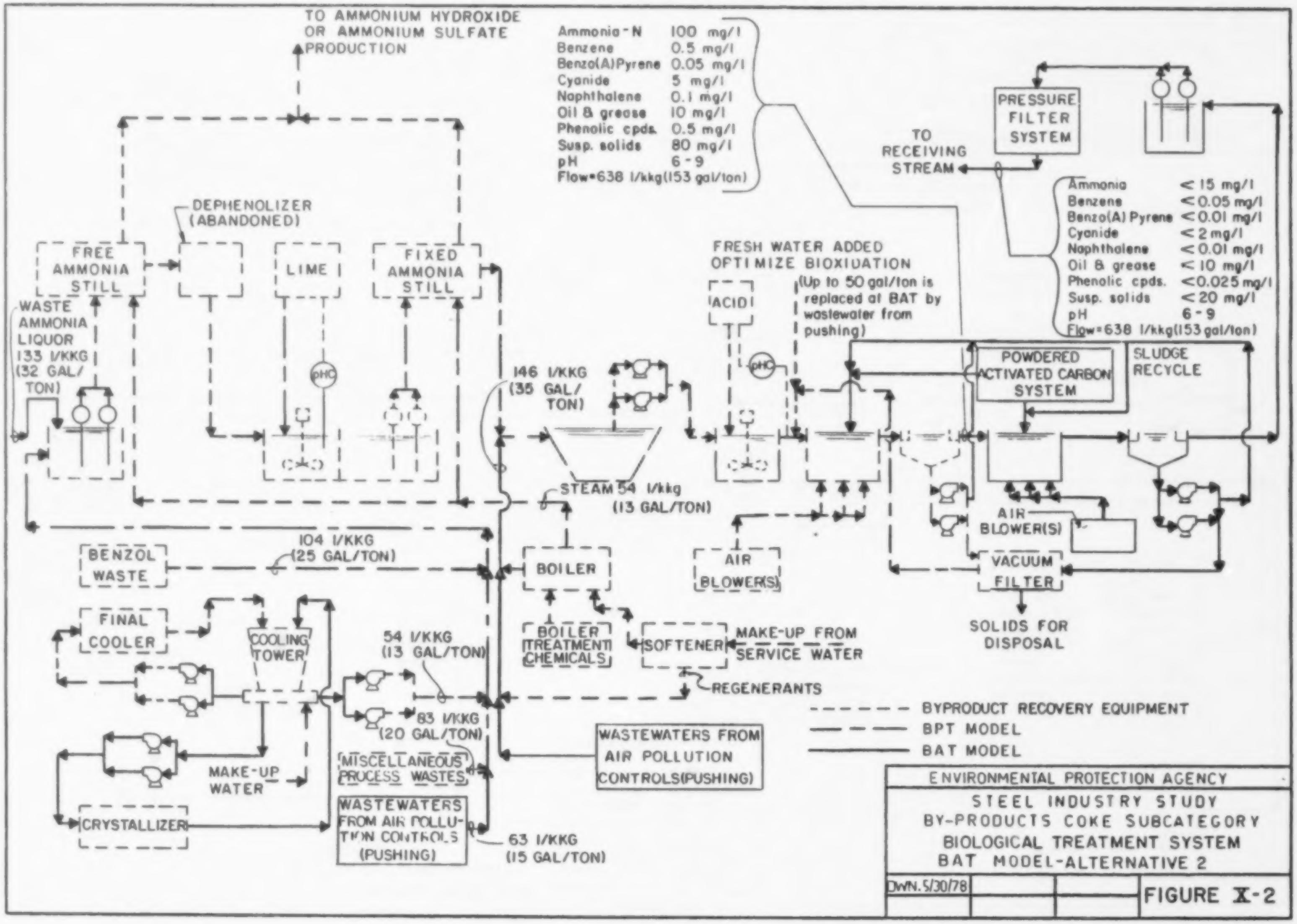
*Detected, but not quantified with sufficient accuracy. Value is <10 micrograms/liter.
ND: Not detected.


TO AMMONIUM HYDROXIDE OR AMMONIUM SULFATE PRODUCTION
AMMONIA-N 100 mg/l
BENZENE 0.5 mg/l
BENZO(A)PIRENE 0.05 mg/l
CYANIDE 5 mg/l
NAPHTHALENE 0.1 mg/l
OIL & GREASE 10 mg/l
PHENOLIC CPDS. 0.5 mg/l
SUSP. SOLIDS 80 mg/l
pH 6-9
FLOW = 638 l/kkg (153 gal/ton)
AMMONIA-N < 15 mg/l
BENZENE < 0.05 mg/l
BENZO(A)PYRENE < 0.02 mg/l
CYANIDE < 2.5 mg/l
NAPHTHALENE < 0.01 mg/l
OIL & GREASE < 10 mg/l
PHENOLIC CPDS. < 0.025 mg/l
SUSP. SOLIDS < 20 mg/l
pH 6-9
FLOW = 638 l/kkg (153 gal/ton)
DEPHENOLIZER (ABANDONED)
FREE AMMONIA STILL
LIME
FIXED AMMONIA STILL
WASTE AMMONIA LIQUOR 133 l/KKG (32 GAL/TON)
FRESH WATER ADDED TO OPTIMIZE BIOXIDATION
(Up to 50 gal/ton is replaced at BAT by wastewater from pushing)
ACID
PH
PRESSURE FILTER SYSTEM
TO RECEIVING STREAM
SLUDGE RECYCLE
146 l/kkg (35 gal/ton)
POND(S)
STEAM 54 l/kkg (13 GAL/TON)
BENZOL WASTE
104 l/kkg (25 GAL/TON)
COOLING TOWER
BLOWDOWN
BOILER
AIR BLOWER(S)
AIR BLOWER(S)
VACUUM FILTER
SOLIDS FOR DISPOSAL
FINAL COOLER
54 l/kkg (13 GAL/TON)
BOILER TREATMENT CHEMICALS
SOFTENER
MAKE-UP FROM SERVICE WATER
REGENERANTS
WASTEWATER FROM AIR POLLUTION CONTROLS (PUSHING)
MAKE-UP WATER
MISCELLANEOUS PROCESS WASTES
83 l/kkg (20 GAL/TON)
CRYSTALLIZER
WASTEWATER FROM AIR POLLUTION CONTROL (PREHEAT & CHARGING)
63 l/kkg (15 GAL/TON)
BYPRODUCT RECOVERY EQUIPMENT
BPT MODEL
BAT MODEL
DWN 6-1-78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY PRODUCT COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
BAT MODEL - ALTERNATIVE I

FIGURE X-1



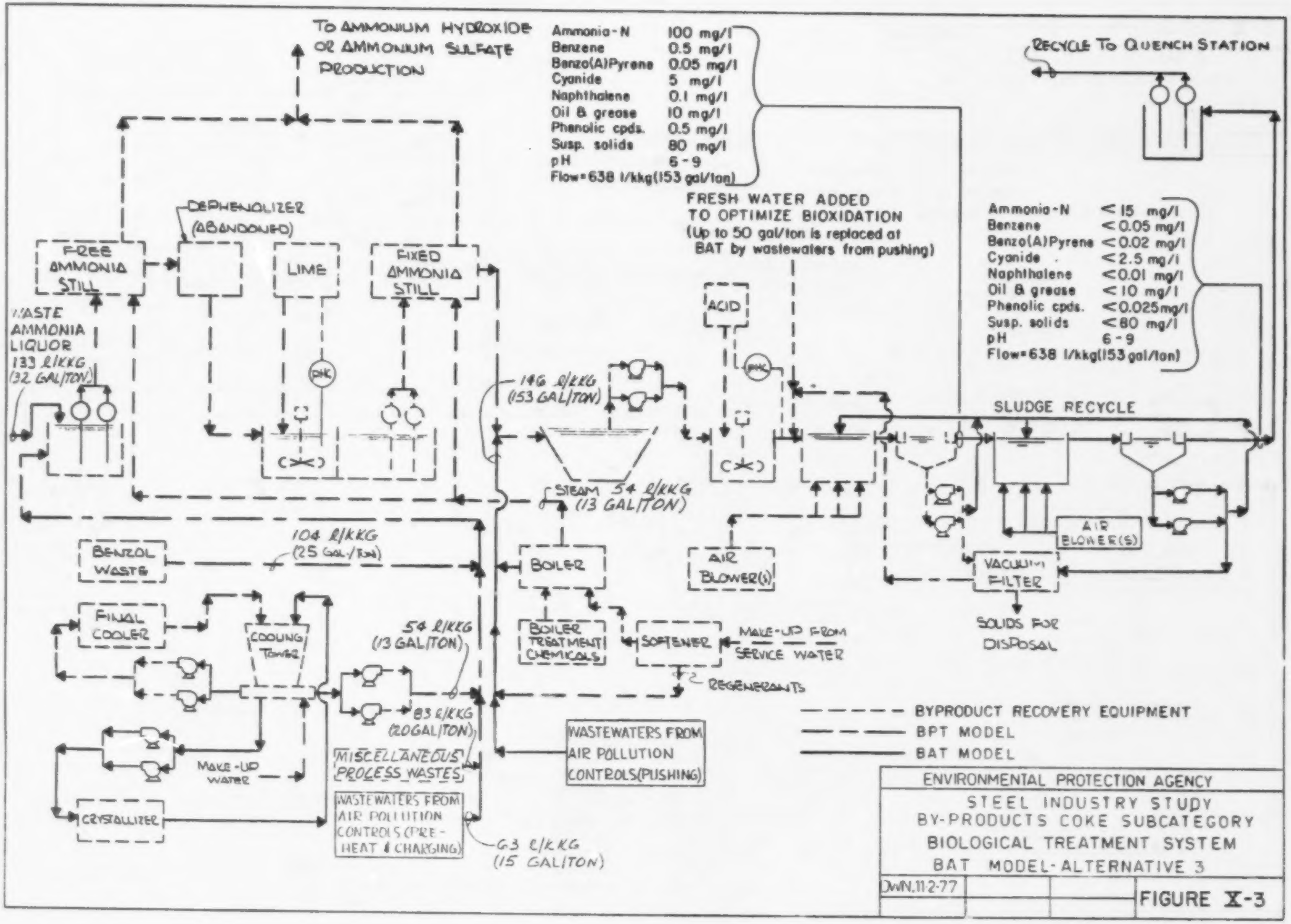
ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCTS COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
BAT MODEL-ALTERNATIVE 2

DWN. 5/30/78

FIGURE X-2

TO AMMONIUM HYDROXIDE OR AMMONIUM SULFATE PRODUCTION
Ammonia-N 100 mg/l
Benzene 0.5 mg/l
Benzo(A)Pyrene 0.05 mg/l
Cyanide 5 mg/l
Naphthalene 0.1 mg/l
Oil & grease 10 mg/l
Phenolic cpds. 0.5 mg/l
Susp. solids 80 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
PRESSURE FILTER SYSTEM
TO RECEIVING STREAM
Ammonia <15 mg/l
Benzene <0.05 mg/l
Benzo(A) Pyrene <0.01 mg/l
Cyanide <2 mg/l
Naphthalene <0.01 mg/l
Oil & grease <10 mg/l
Phenolic cpds. <0.025 mg/l
Susp. solids <20 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
DEPHENOLIZER (ABANDONED)
FREE AMMONIA STILL
LIME
FIXED AMMONIA STILL
WASTE AMMONIA LIQUOR 133 l/KKG (32 GAL/TON)
pHC
FRESH WATER ADDED OPTIMIZE BIOXIDATION
(Up to 50 gal/ton is replaced at BAT by wastewater from pushing)
ACID
pHC
POWDERED ACTIVATED CARBON SYSTEM
SLUDGE RECYCLE
146 l/KKG (35 GAL/TON)
STEAM 54 l/kkg (13 GAL/TON)
AIR BLOWER(S)
AIR BLOWER(S)
VACUUM FILTER
SOLIDS FOR DISPOSAL
104 l/KKG (25 GAL/TON)
BENZOL WASTE
BOILER
FINAL COOLER
COOLING TOWER
54 l/KKG (13 GAL/TON)
83 l/KKG (20 GAL/TON)
BOILER TREATMENT CHEMICALS
SOFTENER
MAKE-UP FROM SERVICE WATER
REGENERANTS
MAKE-UP WATER
MISCELLANEOUS PROCESS WASTES
CRYSTALLIZER
WASTEWATERS FROM AIR POLLUTION CONTROLS (PUSHING)
63 l/KKG (15 GAL/TON)
WASTEWATERS FROM AIR POLLUTION CONTROLS(PUSHING)
BYPRODUCT RECOVERY EQUIPMENT
BPT MODEL
BAT MODEL


TO AMMONIUM HYDROXIDE OR AMMONIUM SULFATE PRODUCTION
Ammonia-N 100 mg/l
Benzene 0.5 mg/l
Benzo(A)Pyrene 0.05 mg/l
Cyanide 5 mg/l
Naphthalene 0.1 mg/l
Oil & grease 10 mg/l
Phenolic cpds. 0.5 mg/l
Susp. solids 80 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
RECYCLE TO QUENCH STATION
FRESH WATER ADDED TO OPTIMIZE BIOXIDATION (Up to 50 gal/ton is replaced at BAT by wastewaters from pushing)
Ammonia-N <15 mg/l
Benzene <0.05 mg/l
Benzo(A)Pyrene <0.02 mg/l
Cyanide <2.5 mg/l
Naphthalene <0.01 mg/l
Oil & grease <10 mg/l
Phenolic cpds. <0.025 mg/l
Susp. solids <80 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
FREE AMMONIA STILL
DEPHENOLIZER (ABANDONED)
LIME
FIXED AMMONIA STILL
WASTE AMMONIA LIQUOR 133 l/KKG (32 GAL/TON)
pH
ACID
pH
146 l/KKG (153 GAL/TON)
SLUDGE RECYCLE
STEAM 54 l/KKG (13 GAL/TON)
104 l/KKG (25 GAL/TON)
BENZOL WASTE
BOILER
AIR BLOWER(S)
AIR BLOWER(S)
VACUUM FILTER
SOLIDS FOR DISPOSAL
FINAL COOLER
COOLING TOWER
54 l/KKG (13 GAL/TON)
BOILER TREATMENT CHEMICALS
SOFTENER
MAKE-UP FROM SERVICE WATER
REGENERANTS
83 l/KKG (20 GAL/TON)
MAKE-UP WATER
MISCELLANEOUS PROCESS WASTES
WASTEWATERS FROM AIR POLLUTION CONTROLS (PUSHING)
CRYSTALLIZER
WASTEWATERS FROM AIR POLLUTION CONTROLS (PRE-HEAT & CHARGING)
63 l/KKG (15 GAL/TON)
BYPRODUCT RECOVERY EQUIPMENT
BPT MODEL
BAT MODEL
DWN. 11-2-77

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCTS COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
BAT MODEL-ALTERNATIVE 3

FIGURE X-3

COKEMAKING SUBCATEGORY

SECTION XI

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY (BCT)

Introduction

The 1977 Amendments added Section 301(b)(4)(E) to the Act, establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(b)(4) - BOD, TSS, fecal coliform and pH - and any additional pollutants defined by the Administrator as "conventional." On July 28, 1978, EPA proposed that COD, oil and grease, and phosphorus be added to the conventional pollutant list (43 Fed. Reg. 32857). Only oil and grease was added.

BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. BCT requires that limitations for conventional pollutants be assessed in light of a new "cost-reasonableness" test, which involves a comparison of the cost and level of reduction of conventional pollutants from the discharge of POTWs to the cost and level of reduction of such pollutants from a class or category of industrial sources. As part of its review of BAT for certain "secondary" industries, EPA proposed methodology for this cost test. (See 43 Fed. Reg. 37570, August 23, 1978).

The methodology for determining best conventional technology used by the Agency is discussed in detail in Section X of Volume I.

Analysis of BCT Control Costs for TSS & Oil and Grease Controls for By-Product Cokemaking Operations

The Agency used the BAT alternative treatment systems present in Section X as a basis for developing BCT alternative treatment systems. The cost of treating TSS and oil and grease to more stringent levels was estimated for each BCT alternative treatment system and are set out in Section VIII in Table VIII-10. A summary of the indusry/POTW cost comparison follows:

	Costs in $/lb of Conventional Pollutant Removed			
	POTW	Alt. 1	Alt. 2	Alt. 3
By-Product Cokemaking	1.34	0.81	0.81	0.46

(All costs are expressed in 7/1/78 dollars).

As shown above, all BCT alternatives provide control of TSS and oil and grease for less than the cost of comparable POTW removal. Thus, each passes the BCT cost test. Since the technology included in BCT

Alternative 3 (disposal by coke quenching) was not selected as the basis for the proposed BAT limitations on the grounds of adverse air quality impacts, it is also not selected as the BCT model treatment system, despite the cost advantage noted above.

Development of BCT Effluent Limitations

Since each of the BCT alternative treatment systems meets the requirements defined under the BCT cost test, the Agency is proposing BCT limitations for TSS and oil and grease based upon the BCT Alternative No. 1 (flow minimization, second stage biological oxidation, clarification and filtration). Physical/chemical systems depend on filtration and carbon adsorption to achieve the same limitations. Refer to Section X for appropriate discussions, and to Table XI-1 for the proposed BCT limitations. Diagrams of the appropriate technology are shown in Figure X-1, and cost data are presented in Section VIII, Tables VIII-9 and VIII- 10.

Justification of the Proposed BCT Limitations

Although none of the biological treatment systems demonstrate compliance with the proposed BCT limitation for TSS of 0.0128 lb/1000 lbs during the plant sampling surveys, this is because none of the biological treatment plants use filtration; a component of the BCT model treatment system. Filtration proved to be effective for the physical/chemical system at Plant 009 in controlling TSS down to 0.0121 lb/1000 lbs, and Plant 002 provided long-term settling to reduce TSS to 0.0009 lb/1000 lbs. The Agency believes that filtering the effluents from biological plants will achieve compliance with proposed BCT limitations for TSS also. At least one biological treatment plant, 0856A, has installed filtration of activated sludge system effluents. The technology has also been demonstrated on a bench scale during verification studies at Plant 003. Five of the 21 daily effluent samples were passed through sand filters, and filtrates contained from 2-5 mg/l TSS, even when feeds were as high as 500 mg/l TSS. Also, during that verification survey, all plant data for October (10 samples) met the proposed BCT 30-day average and daily maximum limitations for TSS, even without filtration. However, when the limitations were exceeded in January, they averaged 2 to 35 times the proposed BCT limitations. A filter would prevent such wide variations.

The Agency is not proposing a 30-day average BCT limitation for oil and grease. Instead, a daily maximum value of 0.00639 lb/1000 lbs is being proposed. For the eleven different plants listed in Table IX-2, ten demonstrate compliance with that limitation; mostly with ease. Long-term data for nearly all plants indicate attainment on a year-round basis for biological and physical/chemical treatment systems. For example, Plant 008 reported four daily maximum values exceeding the proposed BCT limitations for oil and grease over a six month period in 1977, and Plant 009 provided data for 50 weeks of operation, showing an overall average loading of 0.00231 kg/kkg for the direct discharge. Individual concentrations range between 2 and 23 mg/l, averaging 5.6 mg/l. The Agency believes all plants should be able to achieve the proposed BCT limitation for oil and grease with little difficulty.

TABLE XI-1

BCT EFFLUENT LIMITATION GUIDELINES
COKEMAKING SUBCATEGORY

	BCT Effluent Limitations in kg/kkg (lbs/1000 lbs)[1]				
	TSS		O & G[2]		pH (Units)
	Bio.	Phys-Chem.	Bio.	Phys-Chem.	All
A. By-Product Cokemaking Alternative 1*					
1. Basic Limitation	0.0128	0.00859	0.00639	0.00430	6-9
2. Add for Indirect NH_3 Recovery	0.00417	0.00417	0.00209	0.00209	6-9
3. Add for Wet Desulfurization	0.00209	0.00209	0.00104	0.00104	6-9
B. By-Product Cokemaking Alternative 2					
1. Basic Limitation	0.0128	0.00859	0.00639	0.00430	6-9
2. Add for Indirect NH_3 Recovery	0.00417	0.00417	0.00209	0.00209	6-9
3. Add for Wet Desulfurization	0.00209	0.00209	0.00104	0.00104	6-9
C. By-Product Cokemaking Alternative 3					
1. Basic Limitation 2. Add for Indirect NH_3 Recovery 3. Add for Wet Desulfurization	No discharge of process wastewater pollutants to navigable streams				
D. Beehive Cokemaking	No discharge of process wastewater pollutants to navigable streams				

---

*: Selected BCT alternative

(1) 30-day average limitation, except for Oil & Grease. See Note (2). Daily maximum limitation for TSS is 2.67 times the stated limitations.

(2) For Oil & Grease no 30-day average limitation is set. Values shown are daily maximum limitations only.

COKEMAKING SUBCATEGORY

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS (NSPS)

Introduction

The effluent standards which must be achieved by new sources (i.e., any source, the construction of which is started after proposal of new source performance standards; NSPS) are to specify the degree of effluent reduction achievable through the application of the best available demonstrated control technology processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants. While this latter goal is achievable for beehive cokemaking operations, and the Agency has decided to propose NSPS for beehive operations, it is very unlikely that new beehive processes will be built in the future. However, even if some new source were to be built the proposed BPT and BAT limitations (no discharge of wastewater pollutant to navigable streams) would apply to such sources.

For by-product cokemaking, a "no discharge of pollutants" standard is most difficult to attain. The coking operation liberates moisture contained in the coal and, in effect, generates water as a by-product. Water, in excess of the 135 l/kkg (32 gal/ton) that shows up in coke plant effluents, is added and must be disposed. Other sources of coke plant wastewaters are final cooler wastes, benzol plant wastes, coke quenching tower overflows, coke wharf drains, steam condensed in the ammonia stills, cooling tower and boiler blowdowns, cooling system leaks, general washwater used in the coke plant area, and dilution water, if any, used to optimize conditions for biological treatment. In addition, new sources are required to incorporate the latest in air pollution emission controls, which may increase the volumes of water requiring control and treatment.

If no liquid discharge is to be achieved from modern by-product coke plants, a means of total disposal must be found for the 135 liters/kkg (32 gal/ton) of excess flushing liquor which is produced. All of the wastes in this water, with the possible exception of suspended solids, are amenable to pyrolytic decomposition. A rough estimate shows that about 126,000 kilogram calories per metric ton of coke produced would be required to dispose of this waste. This is a negligible percentage of the fuel value of the tar and gas generated in the production of a ton of coke.

However, there is reason to believe that unless very sophisticated means are used to pyrolytically dispose of this water, serious air pollution problems would result. The gases released from less than optimum incineration of this water could be expected to contain high concentrations of the oxides of nitrogen and sulfur and some particulate matter. If a simple incinerator with a wet scrubber were used, the basic pollutants would merely be transferred back to another water stream, thus producing an even larger volume than the original.

Since many of the toxic pollutants in the liquid stream are volatile, evaporation of the liquid to dryness would result in many of the same problems as incineration. In fact, examination of numerous other points of disposal of this stream within an integrated steel mill all yield the same answer. While total pyrolytic decomposition of this small wastewater stream to innocuous gases would be the most desirable method of complete disposal, air pollution impacts and energy constraints render this option impractical.

For the above reasons, the Agency decided not to propose "zero discharge" NSPS for by-product cokemaking.

Identification of NSPS Technology

New Source Performance Standards apply only to sources built after proposal of NSPS. They are applicable to new by-products recovery facilities built at an existing cokemaking site, if such facilities were installed after the NSPS proposal date. Two NSPS alternative treatment systems were considered as appropriate for new sources. Both have biological treatment systems as the principal component, while one of the two includes treatment enhancement using activated carbon. The biological sequence is demonstrated at plant 003 - the most effective of the biosystems surveyed. Adsorption on granular activated carbon is an essential component at plant 009, with demonstrated effectiveness in the control of toxic pollutants. Enhancement using powdered activated carbon (PAC) is currently undergoing testing at several operations. Two coke plants with sophisticated biological treatment systems are investigating the addition of PAC to the aeration basin to enhance removal of carbonaceous material and ammonia.

NSPS Alternative 1

All new cokemaking operations have the opportunity to minimize process wastewater flows, so the first step in both alternatives is the elimination of extraneous water. Dry desulfurizers are available and are recommended for use by new plants, provided they are capable of meeting the air pollution requirements. Operation of certain by-products recovery units may not be part of a new source plans. For example, plants may choose not to refine light oils (less benzol plant wastewater), or not to recover ammonia as an ammonium salt (replaces crystallizer wastewaters with a small volume waste). Even if ammonium sulfate is produced, vacuum crystallizers with steam ejectors should use surface condensers, rather than barometric condensers, or an alternate crystallization system should be used. For those plants where barometric condensers are to be installed, their wastewater can be recycled with only very limited blowdowns to treatment. This latter step is considered to be a pollution control cost, while most of the other means to eliminate water are process related.

Modern and more efficient free and fixed ammonia stills are now available from several sources to provide effective ammonia recovery and cyanide stripping.

All wastewaters are transferred to a holding and equalization basin for detention; pH is adjusted; the wastewaters are then transferred to a two-step or extended biological oxidation system with a clarifier and vacuum filtration of underflows. A final polish of clarifier overflows is provided by filtration. No provision for dilution water is made, since the addition of waters from air pollution emission controls replaces this other water source. Refer to Figure XII-1 for a process flow diagram and Table VIII-11 for costs and quality information.

NSPS Alternative 2

All parts of NSPS Alternative No. 1 are included with provisions for adding powdered carbon to both activated sludge basins. The filtration system prevents carryout of excessive TSS loads. Refer to Figure XII-2 for a diagram of this alternative and Table VIII-11 for costs and effluent quality.

Flow Basis for All NSPS Alternatives

Since new sources are required to install charging, pushing and preheating emissions controls, all NSPS flows include up to 50 gal/ton from these sources. The recycle of barometric condenser wastewaters with a 3 gallon per ton blowdown was included in all alternatives, as were tight recycle of final cooler wastewaters and minimization of flows from benzol plants and miscellaneous sources. The treated wastewater volumes for both alternatives, and consequently the effluent limitations are based on flows of 153 gallons/ton of coke as for BAT. Refer to discussion in Section X, and in particular to Table X-1 for further details on the NSPS model flow.

Response to Court Remand of Flow Basis

A previously proposed 100 gal/ton flow basis for NSPS load calculations was remanded by Third Circuit Court on the grounds that it was "not demonstrated." The only plant in the original survey with a treated effluent flow less than 100 GPT was plant C, and an undetermined portion of its process wastewaters was disposed of by coke quenching.

The additional field sampling survey for toxic pollutants turned up two plants reporting effluent flows below 100 gallons/ton - plants 002 and 009. But even more effective support is provided by Table III-3. Data submitted by 59 operating coke plants indicates that 17 attain total process wastewater flow rates lower than 100 gal/ton. Thus, from plant data, it is evident that the 100 gal/ton flow has been demonstrated by a variety of plants using various disposal means.

Although the 100 gal/ton flow has been effectively demonstrated, NSPS cost estimates and limitations are based on 153 gallons/ton. This increase in flow is intended to reflect the growing trend toward air pollution emissions control with wet scrubbers.

NSPS

The proposed effluent standards for new sources are summarized in Table XII-1. As in the case of the proposed BAT and BCT limits, Alternative No. 1 has been selected as the NSPS model treatment system. Refer to sections X and XI for a discussion of individual pollutants and the ability of existing plants to achieve efficient removal rates for the limited pollutants.

TABLE XII-1

NEW SOURCE PERFORMANCE STANDARDS
COKEMAKING SUBCATEGORY

	NSPS Standards in kg/kkg (lbs/1000 lbs)(1)								
	TSS	O & G(2)	NH_3-N	Cyanides(3)	Phenolic Cpds.(4)	Benzene(5)	Naphthalene(5)	Benzo(a)pyrene(5)	pH Units
A. By-Product Cokemaking Alternative 1*									
1. Basic Standards	0.0128	-	0.00957	0.00160	0.000016	0.000032	0.000006	0.000013	6-9
2. Add for Indirect Ammonia Recovery	0.00417	-	0.00313	0.000521	0.000005	0.000010	0.000002	0.000004	6-9
3. Add for Wet Desulfurization	0.00209	-	0.00156	0.000261	0.000003	0.000005	0.000001	0.000002	6-9
B. By-Product Cokemaking Alternative 2									
1. Basic Standards	0.0128	-	0.00957	0.00128	0.000016	0.000032	0.000006	0.000006	6-9
2. Add for Indirect Ammonia Recovery	0.00417	-	0.00313	0.000417	0.000005	0.000010	0.000002	0.000002	6-9
3. Add for Wet Desulfurization	0.00209	-	0.00156	0.000209	0.000003	0.000005	0.000001	0.000001	6-9
C. Beehive Cokemaking	No Discharge of Process Wastewater Pollutants to Navigable Streams								

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(1) 30-day average NSPS. Daily maximum values are twice the standards stated for cyanides, benzene, naphthalene and benzo(a)pyrene, 2.67 times the stated value for TSS, four times the stated value for phenolic compounds, and 5.34 times the stated value for NH_3-N.

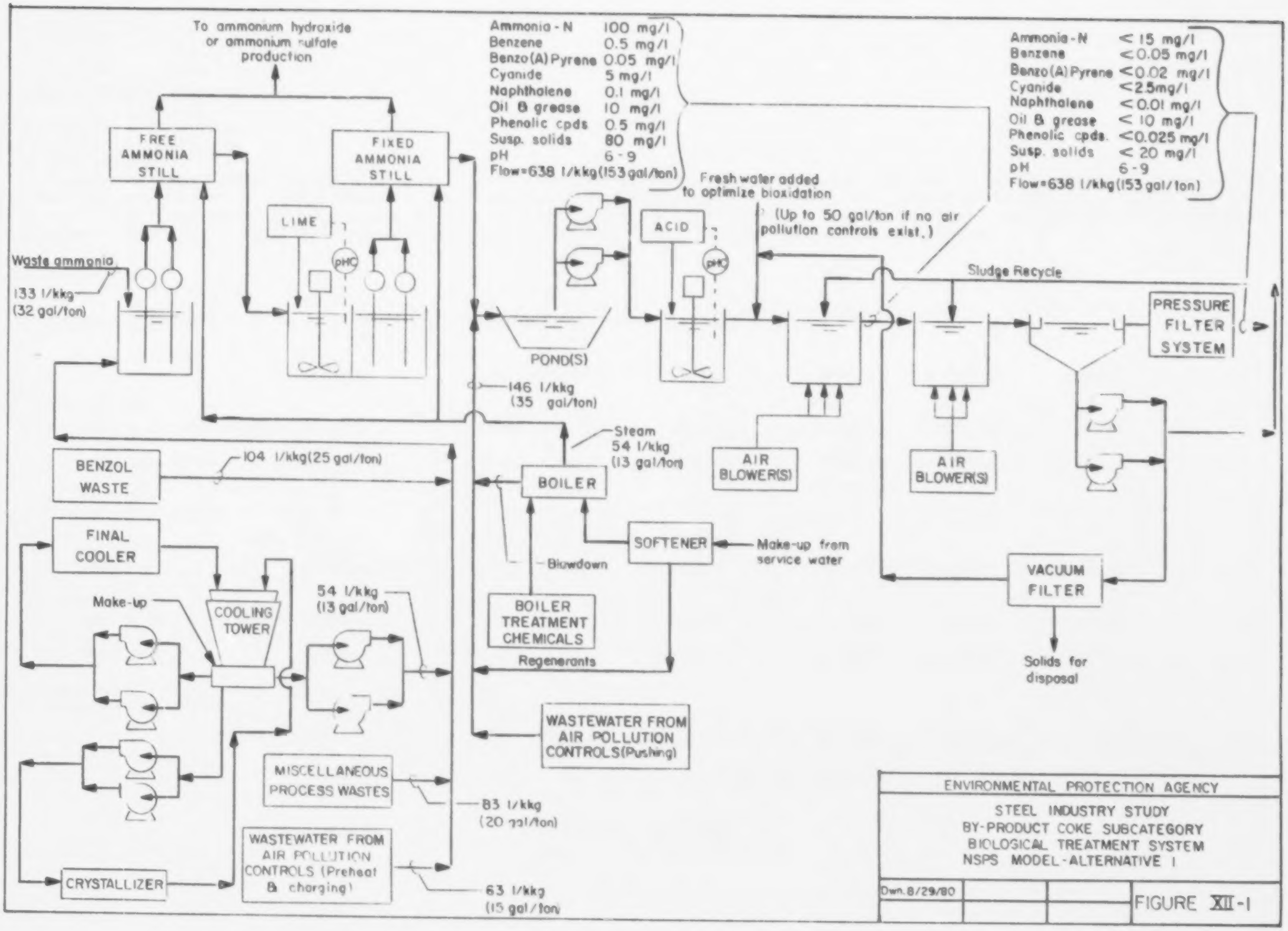
(2) For Oils and Greases, no monthly average is set. A daily maximum value of 0.00639 kg/kkg (lbs/1000 lbs) has been established with add-ons of 0.00209 and 0.00104 kg/kkg (lbs/1000 lbs) for indirect ammonia recovery and wet desulfurization for both by-product cokemaking alternatives.

(3) Total cyanides.

(4) Using 4-AAP test method.

(5) Using GC/MS test method.

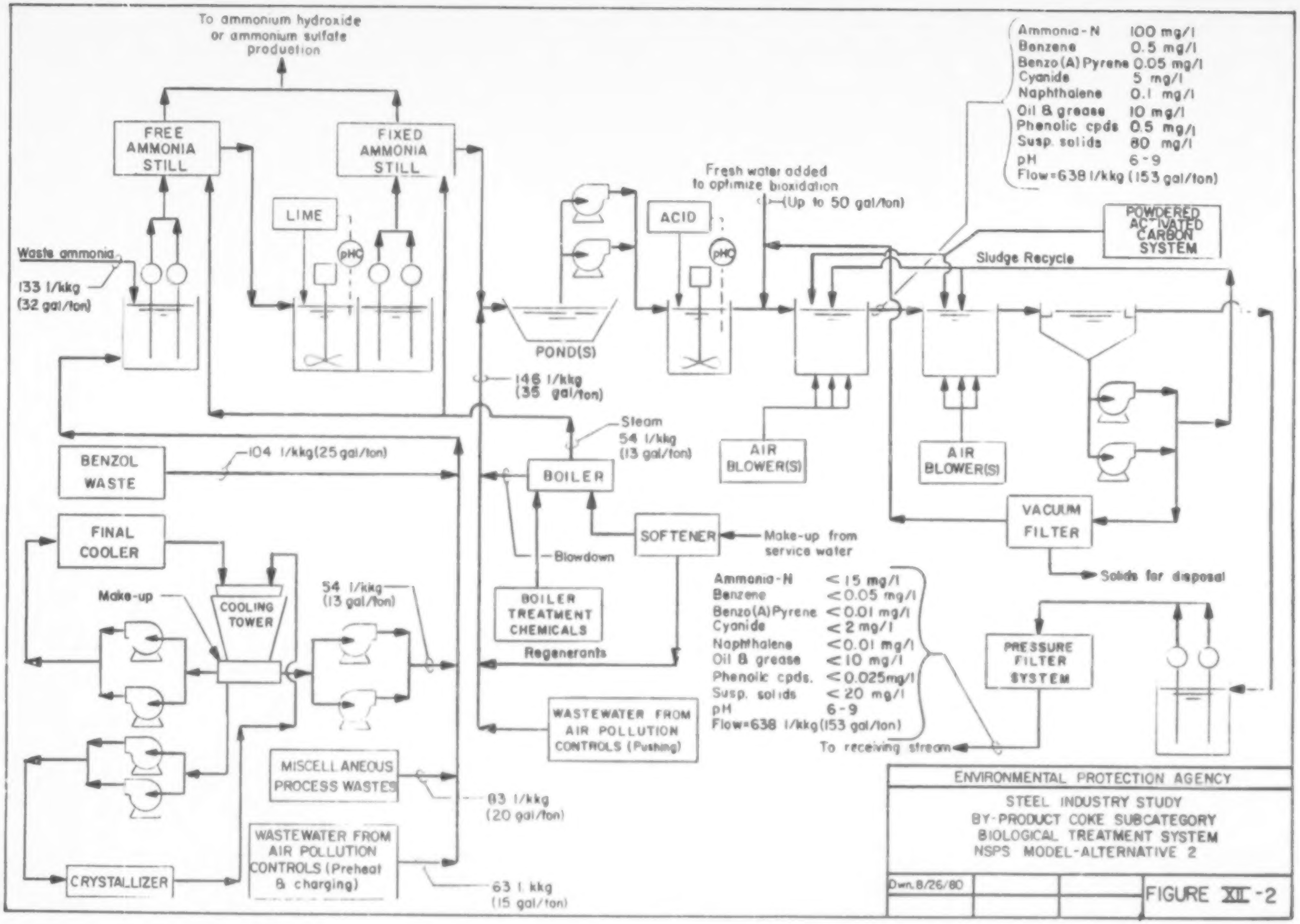
*: Selected NSPS alternative.


To ammonium hydroxide or ammonium sulfate production
FREE AMMONIA STILL
FIXED AMMONIA STILL
LIME
pHC
Waste ammonia
133 l/kkg (32 gal/ton)
Ammonia-N 100 mg/l
Benzene 0.5 mg/l
Benzo(A)Pyrene 0.05 mg/l
Cyanide 5 mg/l
Naphthalene 0.1 mg/l
Oil & grease 10 mg/l
Phenolic cpds 0.5 mg/l
Susp. solids 80 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
POND(S)
ACID
pHC
Fresh water added to optimize bioxidation
(Up to 50 gal/ton if no air pollution controls exist.)
Sludge Recycle
Ammonia-N < 15 mg/l
Benzene <0.05 mg/l
Benzo(A)Pyrene <0.02 mg/l
Cyanide <2.5mg/l
Naphthalene <0.01 mg/l
Oil & grease < 10 mg/l
Phenolic cpds. <0.025 mg/l
Susp. solids < 20 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
PRESSURE FILTER SYSTEM
146 l/kkg (35 gal/ton)
AIR BLOWER(S)
AIR BLOWER(S)
BENZOL WASTE
104 l/kkg(25 gal/ton)
Steam 54 l/kkg (13 gal/ton)
BOILER
SOFTENER
Make-up from service water
Blowdown
VACUUM FILTER
Solids for disposal
FINAL COOLER
Make-up
COOLING TOWER
54 l/kkg (13 gal/ton)
BOILER TREATMENT CHEMICALS
Regenerants
WASTEWATER FROM AIR POLLUTION CONTROLS(Pushing)
MISCELLANEOUS PROCESS WASTES
83 l/kkg (20 gal/ton)
CRYSTALLIZER
WASTEWATER FROM AIR POLLUTION CONTROLS (Preheat & charging)
63 l/kkg (15 gal/ton)
Dwn. 8/29/80

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
NSPS MODEL-ALTERNATIVE I

FIGURE XII-1


To ammonium hydroxide or ammonium sulfate production
FREE AMMONIA STILL
FIXED AMMONIA STILL
LIME
pHC
Waste ammonia
133 l/kkg (32 gal/ton)
POND(S)
ACID
pHC
Fresh water added to optimize bioxidation
(Up to 50 gal/ton)
POWDERED ACTIVATED CARBON SYSTEM
Sludge Recycle
Ammonia-N 100 mg/l
Benzene 0.5 mg/l
Benzo (A) Pyrene 0.05 mg/l
Cyanide 5 mg/l
Naphthalene 0.1 mg/l
Oil & grease 10 mg/l
Phenolic cpds 0.5 mg/l
Susp. solids 80 mg/l
pH 6-9
Flow=638 l/kkg (153 gal/ton)
146 l/kkg (35 gal/ton)
Steam 54 l/kkg (13 gal/ton)
BENZOL WASTE
104 l/kkg (25 gal/ton)
BOILER
AIR BLOWER(S)
AIR BLOWER(S)
VACUUM FILTER
Solids for disposal
FINAL COOLER
Blowdown
SOFTENER
Make-up from service water
Make-up
COOLING TOWER
54 l/kkg (13 gal/ton)
BOILER TREATMENT CHEMICALS
Regenerants
Ammonia-N <15 mg/l
Benzene <0.05 mg/l
Benzo(A)Pyrene <0.01 mg/l
Cyanide <2 mg/l
Naphthalene <0.01 mg/l
Oil & grease <10 mg/l
Phenolic cpds. <0.025 mg/l
Susp. solids <20 mg/l
pH 6-9
Flow=638 l/kkg (153 gal/ton)
PRESSURE FILTER SYSTEM
To receiving stream
WASTEWATER FROM AIR POLLUTION CONTROLS (Pushing)
MISCELLANEOUS PROCESS WASTES
83 l/kkg (20 gal/ton)
WASTEWATER FROM AIR POLLUTION CONTROLS (Preheat & charging)
CRYSTALLIZER
63 l kkg (15 gal/ton)

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
NSPS MODEL-ALTERNATIVE 2

Dwn. 8/26/80

FIGURE XII-2

COKEMAKING SUBCATEGORY

SECTION XIII

PRETREATMENT STANDARDS FOR BY-PRODUCT COKE PLANTS DISCHARGING TO POTWS

Introduction

This section discusses the alternative control and treatment systems available for coke plants which discharge wastewaters to publicly owned treatment works (POTWs). The Agency is not proposing pretreatment standards for beehive cokemaking operations. None of the existing beehive operations discharge to POTWs and it is unlikely that they will ever do so because of their location and the fact that existing beehive operations achieve zero discharge. Even if it could be determined that an existing beehive operator was proposing to discharge indirectly by a POTW, it would be extremely costly to pay sewage charges on a wastewater which can very easily and effectively be eliminated using the BPT model treatment system. Moreover, the General Pretreatment Regulations, 40 CFR Part 403, applicable to all sources, including beehive cokemaking operations, would apply. Accordingly, the Agency has decided not to proposed pretreatment standards for beehive cokemaking plants.

However, the Agency has given separate consideration to two classes of by-product cokemaking operations: existing sources and new sources. The general pretreatment and categorical pretreatment standards applying to cokemaking operations are discussed below.

General Pretreatment Standards

For detailed information on Pretreatment Standards refer to 43 FR 27736-27773, "General Pretreatment Regulations for Existing and New Sources of Pollution," (June 26, 1978). In particular, 40 CFR Part 403 describes national standards (prohibited discharges and categorical standards), revision of categorical standards, and POTW pretreatment programs.

In establishing pretreatment standards for by-product cokemaking operations, the Agency gave primary consideration to the objectives and requirements of the General Pretreatment Regulations. In addition, the Agency considered additional factors specifically applicable to by-product cokemaking operations which are discussed below.

The General Pretreatment Regulations set forth general discharge prohibitions that apply to all nondomestic users of a POTW to prevent pass-through of pollutants, interference with the operation of a POTW, and municipal sludge contamination. The regulations also establish administrative mechanisms to ensure application and enforcement of prohibited discharge limits and categorical pretreatment standards.

In addition, the Regulations contain provisions relating directly to the determination of and reporting on Pretreatment Standards.

Although wastewaters from a significant number of operating by-product coke plants are discharged to POTWs, POTWs are usually not designed to treat the toxic pollutants and other pollutants such as ammonia, thiocyanate, and sulfide which are present in by-product coke plant wastewaters. Instead, POTWs are designed to treat biochemical oxygen demand (BOD), suspended solids (TSS), fecal coliform bacteria, and pH. Whatever removal obtained by POTWs for toxic pollutants is incidental to the POTW's main function of treating conventional pollutants. POTWs have historically accepted large amounts of many pollutants well above their capacity to treat them adequately. As the issue of municipal sludge use has become more important, pretreatment standards must address toxic pollutant removal, rather than transfer of these pollutants to POTWs where many pollutants concentrate in the sludges.

Due to the presence of many toxic pollutants in wastewaters from by-product cokemaking, extensive pretreatment must be provided to ensure that these pollutants do not interfere with, pass through, or are otherwise incompatible with POTW operations or cause harm to the treatment plant. In general, the pretreatment wastewater treatment technologies are the same as those for BAT. The Agency is not proposing pretreatment standards for suspended solids and oil and grease because these pollutants in the amounts present in BAT cokemaking effluents are compatible with POTW operations and can be effectively treated at POTWs. Nonconventional and toxic pollutants are reviewed below.

Pretreatment Considerations for Cokemaking

Ammonia-N

Most POTWs in the United States are not designed for nitrification. Hence, aside from incidental removal, most if not all of the ammonia-N introduced into POTWs from cokemaking operations will pass through into receiving waters without treatment. Depending on the size of the POTW and the volume of and pretreatment provided for cokemaking wastes, operating problems may not be experienced at the POTW because of dilution, but, nonetheless, the ammonia-N discharged to the POTW will pass through untreated.

The discharge from Plant 0584B to the Detroit sewerage system provides an excellent example of the above. Waste ammonia liquors from the coke plants at Plant 0584B are pretreated with free ammonia stills and dephenolizers prior to discharge to the Detroit sewerage system with sanitary wastes and minor miscellaneous coke plant sources. Final cooler wastes, benzol plant wastes, and pushing emission control wastes are disposed of by coke quenching. The ammonia-N discharge from Plant 0584B to the Detroit sewerage treatment plant ranges between 12,000 and 15,000 lbs/day. Since the Detroit sewage treatment plant is designed to provide secondary treatment (no ammonia-N removal) for 800 MGD, the coke plant waste is diluted and does not interfere with POTW operations, but does not receive treatment for ammonia-N. Hence, virtually the total coke plant discharge continues to reach the Detroit River unabated. The monthly average BPT and BAT effluent limitations for ammonia-N for Plant 0584B are about 946 lbs/day and 99 lbs/day, respectively, based on the limitations proposed herein.

Another example of lack of POTW treatment for ammonia-N resulting from cokemaking operations is provided by the East Chicago Indiana sewage treatment plant. This facility receives partially treated coke plant wastes from Plants 0384A and 0948C. Recent investigations of this facility by Region V of EPA show the plant is experiencing significant operating problems, notably with respect to sludge handling and overall efficiency. The Region attributes many of the problems at this facility to coke plant wastes. Notwithstanding the above, data for the East Chicago sewage treatment plant demonstrate this facility does not remove or otherwise treat ammonia-N. Hence, the ammonia-N discharges from Plants 0384A and 0948C pass through untreated.

Based upon the current practice at these and other coke plant/POTW systems, the Agency concludes that to insure comparable and effective treatment for ammonia-N from coke plants discharging to POTWs, the proposed pretreatment standards for existing and new sources should be equal to the proposed BAT and NSPS limitations and standards, respectively.

Total Cyanide

As noted in Volume I, Section V, cyanide compounds can interfere with the operation of and pass through POTWs, as well as enhance the toxicity of metals commonly found in POTW effluents. The mean pass through of cyanide for fourteen biological plants was found to be 71%. Based upon cyanide pass through and the operating problems of the East Chicago Indiana sewage treatment plant discussed earlier, the Agency concludes that pretreatment standards for new and existing sources for total cyanide should be equal to the proposed NSPS and BAT limitations and standards, respectively.

Phenolic Compounds

While phenol and phenolic compounds can be effectively treated in POTWs with properly acclimated systems, the Agency is using phenolics (4-AAP) as an indicator pollutant, along with three specific toxic organic pollutants, for other toxic organic pollutants discussed below. Hence, the proposed pretreatment standards for new and existing sources are the same as the proposed BAT and NSPS limitations and standards.

Toxic Organic Pollutants

Raw and partially treated cokemaking wastewaters from several coke plants containing high concentrations of toxic organic pollutants are currently discharged to POTWs. Based upon the information and data presented in Volume I, the Agency concludes that pretreatment standards for the toxic organic pollutants found in cokemaking wastewaters should be proposed at levels similar to the respective proposed BAT and NSPS limitations and standards. Many of these pollutants are degraded to only a limited extent in POTWs and most tend to concentrate in POTW sludges. The Agency believes that to minimize the distribution of these pollutants in the environment it is prudent to limit discharges to POTWs to the proposed BAT levels.

PSES Alternative 1

The first step is the minimization of process wastewater flows by recycle of final cooler and barometric condenser wastewaters. Following recovery of by-products by free ammonia stripping and dephenolization, treatment continues with lime addition, fixed ammonia stripping, equalization and detention in a settling basin, two stage or extended biological oxidation and filtration prior to release to sanitary sewers. All pollutants which are detrimental to POTW operations are significantly reduced. Refer to Figure XIII-1 for a diagram of this system, and to Table VIII-13 for costs and effluent qualities.

PSES Alternative 2

Treatment alternative 2 adds powdered carbon to the above system. This alternative produces slightly lower levels of TSS and O&G, metals, and organic pollutants such as naphthalene. A diagram of Alternative 2 appears as Figure XIII-2 and costs and effluent qualities are shown in Table VIII-13.

Pretreatment Standards

The limitations applicable to existing source POTW dischargers are shown in Table XIII-1 for the selected alternative for each pollutant. Alternative 1 has been selected as the PSES model treatment system. For New Sources (PSNS), the standards are identical to those for direct new source dischargers. Refer to Section XII for NSPS limitations, technologies, and costs. Refer also to 43 FR27736, et seq., for "General Pretreatment Regulations for Existing and New Sources of Pollutant; Monday, June 26, 1978."

TABLE XIII-1

PRETREATMENT STANDARDS FOR EXISTING SOURCES
COKEMAKING SUBCATEGORY

	PSES Effluent Standards in kg/kkg (lbs/1000 lbs)(1)					
	NH3-N	Cyanides(2)	Phenolic Compounds(3)	Benzene(4)	Naphthalene(4)	Benzo(a)pyrene(4)
A. By-Product Cokemaking Alternative 1*						
1. Basic Standard	0.00957 0.0258 (5)	0.00160 (5) ____	0.000016 0.000022 (5)	0.000032 0.000022 (5)	0.000006 0.000004 (5)	0.000013 0.000009 (5)
2. Add for Indirect Ammonia Recovery	0.00313 0.0125 (5)	0.000521 (5) ____	0.000005 0.000010 (5)	0.000010	0.000002	0.000004
3. Add for Wet Desulfurization	0.00156 0.00626 (5)	0.000261 (5) ____	0.000003 0.000005 (5)	0.000005	0.000001	0.000002
B. By-Product Cokemaking Alternative 2						
1. Basic Standard	0.00957 0.0258 (5)	0.00128 (5) ____	0.000016 0.000022 (5)	0.000032 0.000022 (5)	0.000006 0.000004 (5)	0.000006 0.000009 (5)
2. Add for Indirect Ammonia Recovery	0.00313 0.0125 (5)	0.000417 (5) ____	0.000005 0.000010 (5)	0.000010	0.000002	0.000002
3. Add for Wet Desulfurization	0.00156 0.00626 (5)	0.000209 (5) ____	0.000003 0.000005 (5)	0.00005	0.000001	0.000001
C. Beehive Cokemaking	Not Applicable - No Discharge					

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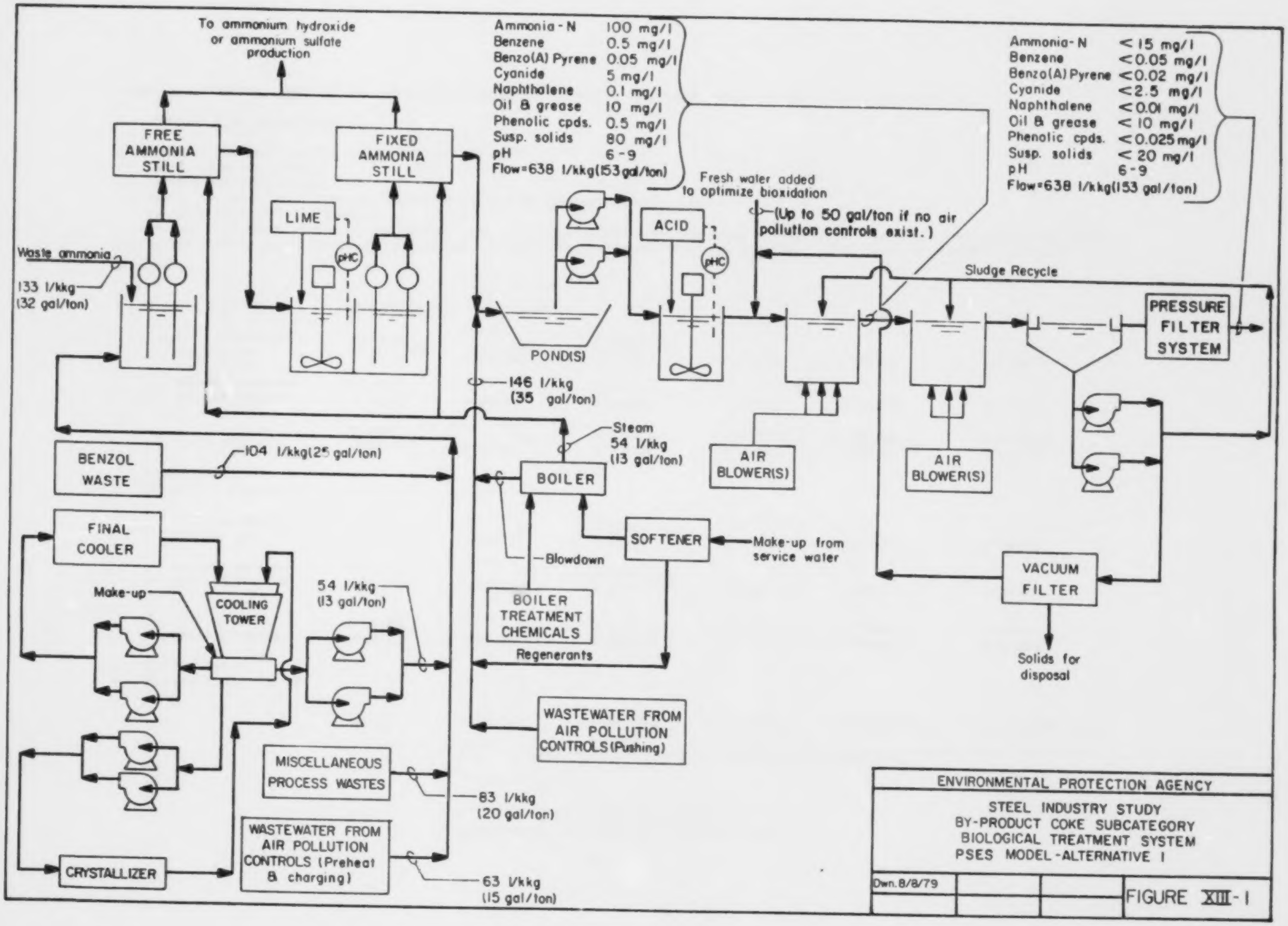
(1) 30-day average PSES. Daily maximum values are twice the standards stated for cyanides, NH$_3$-N (physical-chemical systems), naphthalene, benzo(a)pyrene, and benzene, four times the stated value for phenolic compounds, and 5.34 times the stated value for NH$_3$N (biological systems.)
(2) Total cyanides. Note that no limitation applies to physical-chemical treatment systems.
(3) Using 4-AAP test method.
(4) Using GC/MS test method.
(5) Standard for physical-chemical treatment systems.

* : Selected PSES Alternative

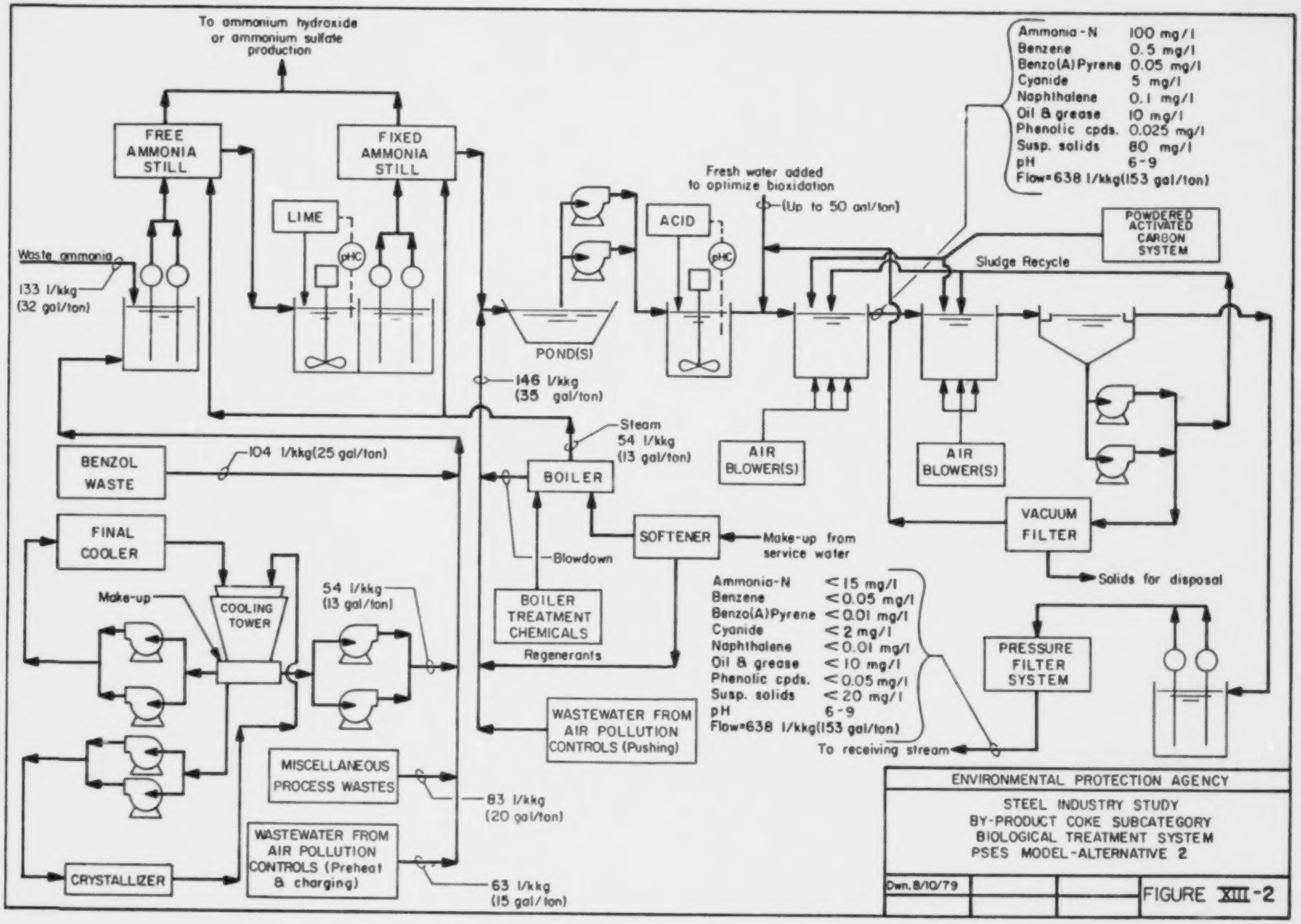
NOTE: Pretreatment Standards for New Sources (PSNS) are identical with NSPS. Refer to Table XII-1 for details


To ammonium hydroxide or ammonium sulfate production
FREE AMMONIA STILL
FIXED AMMONIA STILL
LIME
pHC
Waste ammonia
133 l/kkg (32 gal/ton)
Ammonia-N 100 mg/l
Benzene 0.5 mg/l
Benzo(A) Pyrene 0.05 mg/l
Cyanide 5 mg/l
Naphthalene 0.1 mg/l
Oil & grease 10 mg/l
Phenolic cpds. 0.5 mg/l
Susp. solids 80 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
Fresh water added to optimize bioxidation
(Up to 50 gal/ton if no air pollution controls exist.)
ACID
pHC
POND(S)
146 l/kkg (35 gal/ton)
Sludge Recycle
Ammonia-N <15 mg/l
Benzene <0.05 mg/l
Benzo(A) Pyrene <0.02 mg/l
Cyanide <2.5 mg/l
Naphthalene <0.01 mg/l
Oil & grease <10 mg/l
Phenolic cpds. <0.025 mg/l
Susp. solids <20 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
PRESSURE FILTER SYSTEM
AIR BLOWER(S)
AIR BLOWER(S)
VACUUM FILTER
Solids for disposal
BENZOL WASTE
104 l/kkg(25 gal/ton)
Steam 54 l/kkg (13 gal/ton)
BOILER
SOFTENER
Make-up from service water
Blowdown
BOILER TREATMENT CHEMICALS
Regenerants
FINAL COOLER
Make-up
COOLING TOWER
54 l/kkg (13 gal/ton)
CRYSTALLIZER
MISCELLANEOUS PROCESS WASTES
83 l/kkg (20 gal/ton)
WASTEWATER FROM AIR POLLUTION CONTROLS (Pushing)
WASTEWATER FROM AIR POLLUTION CONTROLS (Preheat & charging)
63 l/kkg (15 gal/ton)
Dwn.8/8/79

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
PSES MODEL-ALTERNATIVE I

FIGURE XIII-1


To ammonium hydroxide or ammonium sulfate production
FREE AMMONIA STILL
FIXED AMMONIA STILL
LIME
pHC
ACID
pHC
Waste ammonia
133 l/kkg (32 gal/ton)
POND(S)
146 l/kkg (35 gal/ton)
Fresh water added to optimize bioxidation
(Up to 50 gal/ton)
Ammonia-N 100 mg/l
Benzene 0.5 mg/l
Benzo(A)Pyrene 0.05 mg/l
Cyanide 5 mg/l
Naphthalene 0.1 mg/l
Oil & grease 10 mg/l
Phenolic cpds. 0.025 mg/l
Susp. solids 80 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
POWDERED ACTIVATED CARBON SYSTEM
Sludge Recycle
AIR BLOWER(S)
AIR BLOWER(S)
VACUUM FILTER
Solids for disposal
BENZOL WASTE
104 l/kkg(25 gal/ton)
Steam 54 l/kkg (13 gal/ton)
BOILER
SOFTENER
Make-up from service water
Blowdown
BOILER TREATMENT CHEMICALS
Regenerants
FINAL COOLER
Make-up
COOLING TOWER
54 l/kkg (13 gal/ton)
WASTEWATER FROM AIR POLLUTION CONTROLS (Pushing)
MISCELLANEOUS PROCESS WASTES
83 l/kkg (20 gal/ton)
WASTEWATER FROM AIR POLLUTION CONTROLS (Preheat & charging)
63 l/kkg (15 gal/ton)
CRYSTALLIZER
Ammonia-N <15 mg/l
Benzene <0.05 mg/l
Benzo(A)Pyrene <0.01 mg/l
Cyanide <2 mg/l
Naphthalene <0.01 mg/l
Oil & grease <10 mg/l
Phenolic cpds. <0.05 mg/l
Susp. solids <20 mg/l
pH 6-9
Flow=638 l/kkg(153 gal/ton)
PRESSURE FILTER SYSTEM
To receiving stream
Dwn. 8/10/79

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
PSES MODEL-ALTERNATIVE 2

FIGURE XIII-2

SINTERING SUBCATEGORY

SECTION I

PREFACE

The USEPA is proposing effluent limitations guidelines and standards for the steel industry. The proposed regulation contains effluent limitations for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT) as well as pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards (NSPS), pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act.

This part of the Development Document highlights the technical aspects of EPA's study of the Sintering Subcategory of the Iron and Steel Industry. Volume I of the Development Document discusses issues pertaining to the industry in general, while other volumes relate to the individual subcategories of the industry.

SINTERING SUBCATEGORY

SECTION II

CONCLUSIONS

Based upon this study and a review of its previous studies of the steel industry, the Agency has reached the following conclusions concerning sintering operations:

1. The Agency is retaining one subcategory for all sintering operations. The expanded data base confirmed that further subdivision is not warranted.

2. The data indicate that the BPT effluent limitations originally promulgated (1974) for sintering operations did not sufficiently account for wastewater discharges from all sintering wastewater sources. Accordingly, the Agency is proposing less stringent BPT effluent limitations for suspended solids and oil and grease. Compliance with the proposed BPT limitations is demonstrated by systems treating both machine (windbox) and discharge end wastewaters.

3. The Agency's monitoring of sintering process wastewaters revealed significant concentrations of four toxic organic and seven toxic metal pollutants. The Agency concluded that the discharge of these pollutants can be controlled by available, economically achievable technologies. A summary of raw waste loadings and the discharges resulting from attainment of the proposed BPT, BAT, and BCT limitations is presented below.

	Effluent Discharges (Tons/Year)		
	Raw Waste	Proposed BPT	Proposed BAT and BCT
Flow (MGD)	122.6	8.4	6.3
TSS	1,138,650	639	144
Oil and Grease	45,716	128	47.9
Toxic Metals	616	24.3	6.7
Toxic Organics*	5.6	1.5	1.2
Fluoride	1,120	384	95.9
Cyanide, Total	37.3	6.4	2.4
Phenols (4AAP)	37.3	25.6	1.0

* Toxic organics do not include phenols (4AAP), the invididual phenolic compounds and cyanide.

4. The Agency's estimates of the costs of compliance with the proposed BPT, BAT, and BCT limitations for the sintering subcategory are presented below for facilities in place as of January 1, 1978.

	Costs (Millions of July 1, 1978 Dollars)			
	Investment Costs			Annual
	In-Place	Required	Total	Costs
BPT	46.3	27.9	74.2	37.3
BAT	2.0	11.3	13.3	2.6

NOTE: BAT costs are in addition to BPT costs.
BCT and PSES costs are included in the BPT and BAT costs.

5. The BPT and BAT model treatment systems for the sintering subcategory include wastewater recycle. Responses from the industry regarding several sintering operations indicate that the recycle systems in use at these plants do not present any problems with respect to scaling, fouling or plugging. The Agency has therefore concluded that the use of recycle systems is a reasonable and demonstrated method of achieving the limitations for this subcategory.

6. The Agency evaluated the "cost/reasonableness" of controlling the conventional pollutants found in sintering wastewaters, (i.e., suspended solids and oil and grease) and found that the control costs, based upon a BCT model treatment system, are less than those for publicly owned treatment works (POTWs). Therefore the Agency has proposed BCT effluent limitations for the conventional pollutants based upon the BCT model treatment system.

7. Proposed NSPS for sintering operations using wet methods of air pollution control are the same as the proposed BAT effluent limitations and are based upon the same wastewater treatment technologies. It is recognized that new source sintering operations may install "dry" systems which do not generate any process wastewaters.

8. EPA is proposing pretreatment standards for new and existing sources (PSNS and PSES) discharging to POTWs which limit the amount of toxic pollutants which can be introduced into a POTW. These standards are intended to minimize the impact of pollutants which interfere with, pass through, or are otherwise incompatible with POTW operations.

9. Although four toxic organic and seven toxic metal pollutants were found in the raw wastewaters from sintering operations, the Agency believes it is not necessary to propose limitations for each toxic pollutant. The Agency believes that adequate control of toxic organic pollutants can be achieved by the control of total cyanide and phenols (4AAP). Likewise, control of lead and zinc will result in removal of other toxic metal pollutants.

10. To facilitate less costly central treatment and to make the sintering limitations compatible with the ironmaking limitations, the Agency is proposing effluent limitations for ammonia-N for sintering.

11. With regard to "remand issues," the Agency concludes that:

a. Regarding the use of tight recycle systems for sintering operations, the discharge flow of 75 gal/ton for new sources has been demonstrated. The effluent flows at two plants equal or closely approach the NSPS treatment model effluent flow. This is the same demonstrated effluent flow used as a basis for developing the BAT, PSES and PSNS model treatment systems.

b. The estimated cost to install a wastewater treatment system is not affected by whether it is an "initial fit" or a "retrofit". In addition, the ability to implement various wastewater treatment practices is not affected by plant age. A comparison of actual costs (reported for the plants visited or in the Detailed Data Collection Portfolio, i.e., D-DCP, responses) with EPA's cost estimates developed from treatment models indicates that the estimated subcategory treatment costs are sufficiently generous to cover all site-specific and other incidental costs.

c. The treatment technologies incorporated in the various model treatment systems will not cause any significant impacts on the consumptive use of water.

12. Table II-1 presents the treatment model flow and effluent quality data used to develop the proposed BPT effluent limitations for the sintering subcategory, and Table II-2 presents these proposed limitations. Table II-3 presents the treatment model flow and effluent quality data used to develop the proposed BAT and BCT effluent limitations and the proposed NSPS, PSES, and PSNS for the sintering subcategory; Table II-4 presents these proposed limitations and standards.

TABLE II-1

BPT TREATMENT MODEL FLOW AND EFFLUENT QUALITY SINTERING SUBCATEGORY

Pollutant	Monthly Average Concentration (mg/l)(1)
Flow, gal/ton	100
TSS	50
Oil and Grease	10
pH, Units	6.0-9.0

---

(1) Daily maximum concentrations are three times the above monthly average concentrations.

TABLE II-2

PROPOSED BPT EFFLUENT LIMITATIONS SINTERING SUBCATEGORY

Pollutant	Effluent Limitations(1) (kg/kkg of Product)
TSS	0.0208
Oil & Grease	0.0042
pH, Units	Within the range of 6.0-9.0

---

(1) Daily maximum effluent limitations are three times the above monthly average effluent limitations.

TABLE II-3

TREATMENT MODEL FLOWS AND EFFLUENT QUALITY
SINTERING SUBCATEGORY

	Pollutant	Monthly Average Concentrations (mg/l)(1)				
		BAT	BCT	NSPS	PSES	PSNS
	Flow, gal/ton	75	75	75	75	75
	TSS	-	15	15	-	-
	Oil and Grease	-	10*	10*	-	-
	Ammonia (N)	1.0	-	1.0	1.0	1.0
121	Total Cyanide	0.25	-	0.25	0.25	0.25
	Phenolics (4AAP)	0.10	-	0.10	0.10	0.10
	TRC	0.5*	-	0.5*	0.5*	0.5*
122	Lead	0.10	-	0.10	0.10	0.10
128	Zinc	0.10	-	0.10	0.10	0.10
	pH, Units	-	6.0-9.0	6.0-9.0	-	-

---

(1) Daily maximum concentrations are the above monthly average concentrations multiplied by the following factors:

Pollutant(s)	Factor
TSS	2.67
Ammonia (N), Total Cyanide, Phenolics (4AAP)	2.0
Lead, Zinc	3.0

*: As shown, daily maximum concentrations only.

TABLE II-4

PROPOSED EFFLUENT LIMITATIONS AND STANDARDS
SINTERING SUBCATEGORY

	Pollutant	Effluent Limitations and Standards (kg/kkg of Product)(1)				
		BAT	BCT	NSPS	PSES	PSNS
	TSS	-	469	469	-	-
	Oil and Grease	-	313*	313*	-	-
	Ammonia (N)	31.3	-	31.3	31.3	31.3
121	Total Cyanide	7.82	-	7.82	7.82	7.82
	Phenolics (4AAP)	3.13	-	3.13	3.13	3.13
	TRC	15.6*	-	15.6*	15.6*	15.6*
122	Lead	3.13	-	3.13	3.13	3.13
128	Zinc	3.13.	-	3.13	3.13	3.13
	pH, Units	-	Within the range 6.0-9.0		-	-

---

(1) The proposed limitations and standards have been multiplied by 10^5 to obtain the values presented in this table. Daily maximum limitations and standards are the above monthly average limitations and standards multiplied by the following factors.

Pollutant(s)	Factor
TSS	2.67
Ammonia (N), Total Cyanide, Phenolics (4AAP)	2.0
Lead, Zinc	3.0

*: As shown, daily maximum limitations and standards only.

SINTERING SUBCATEGORY

SECTION III

INTRODUCTION

Discussion

During iron and steel production operations, large quantities of particulate matter (fines, mill scale, flue dust) are generated by blast furnaces; open hearth, electric arc, and basic oxygen furnaces; and hot forming mills. This particulate matter is removed from process gases, by dry or wet air pollution control devices, to reduce air emissions or to clean the gases for reuse as fuel. Mill scale is recovered from wastewaters discharged from hot forming operations. A large percentage of this iron rich material is recovered through the sintering operation. The fused material (sinter) produced by the sintering operation is reused as raw material in blast furnaces.

Description of the Sintering Process

Sintering is an agglomeration process in which iron bearing materials, (generally fines) are mixed with iron ore, limestone, and finely divided fuel such as coke breeze. The fines consist primarily of mill scale and dust from basic oxygen furnaces, open hearth furnaces, electric arc furnaces, and blast furnaces. Mixers (e.g., ball drums) are used to mix the raw materials before they are placed on the traveling grate of the sinter machine. Near the head end of the grate, the surface of the raw materials is ignited by a gas fired ignition furnace located over the bed. As the mixture moves along on the traveling grate, air is drawn down through the mixture at the wind boxes to enhance combustion and to sinter (fuse) the fine particles. As the bed burns, carbon dioxide, cyanides, sulfur compounds, chlorides and fluorides are driven off with the gases. Oil and grease on the mill scale is vaporized and driven off.

The sinter drops off the grate at the discharge end of the machine and is cooled (either by air or a water spray), crushed and screened. Screening is necessary to maintain uniformity in the size of the sinter fed to blast furnaces. Improperly sized sinter and the fines from the screening operation are returned to the operation for reprocessing. Wastewaters are generated in this process primarily as a result of scrubbing the gases and dusts associated with the sintering process. Wastewaters are also discharged if excess water is used to cool the sinter. The sintering operation wastewater sources are depicted in the process flow diagrams (Figures III-1, III-2 and III-3).

Eleven of the thirty-two sinter plants in the United States do not generate any process wastewaters since dry air pollution control equipment is used at these plants. Dry air pollution control equipment includes cyclonic dust collectors or, with newer operations, fabric type dust filters. The "dry" plants are included in the

Summary Table III-1 but are excluded from further review because they do not generate any process wastewaters.

Sinter production capacity ranges from 540 to 12,200 tons/day for "wet" plants and from 1,132 to 16,600 tons/day for "dry" plants (Table III-3). The total rated capacity of all plants (excluding the capacity of one plant which was claimed to be confidential) is 145,312 tons/day. "Wet" plants comprise about 58% of the total capacity.

Wastewaters are generated in sintering operations as a result of scrubbing dusts and gases generated during raw material handling, the sintering process, and crushing, screening and cooling the sinter. The pollutants generated in sintering operations include suspended solids and oil and grease, as well as toxic inorganic and organic pollutants.

The originally promulgated (1974) regulation for sintering operations included effluent limitations for the following pollutants:

Total Suspended Solids
Oil and Grease
pH

Data Collection Activities

For this study, the Agency conducted additional sampling and gathered detailed information from the industry to provide an expanded data base for the proposed limitations. The primary sources of industry information were the DCP (basic questionnaire) responses. The DCP requested information pertaining to production processes, process water usage, process wastewater discharge, and wastewater treatment systems. The Agency received DCP responses from every sintering operation. These data have been summarized and are presented in Table III-1.

Detailed questionnaires (D-DCPs) were sent to five plants. The D-DCPs sought long-term treatment facility analytical and operating cost data, and sintering process operating data. The D-DCP responses assisted in verifying cost estimates, and establishing retrofit costs. Only two plants provided long-term analytical data relating to the previously limited BPT pollutants. No data were provided for toxic metal and toxic organic pollutants.

The Agency identified 32 steel plants with sintering operations. One plant claimed confidentiality with regard to all data submitted. These data are not included in Table III-1. The Agency visited four plants during the original guidelines survey. The Agency determined that data for three of these plants were unusable; one did not supply requested cost or production data; another operation treated sintering wastewaters in combination with another wastewater treatment system thereby, making treatment predictions difficult; and the third plant had problems with equipment during the sampling survey and the sintering wastewater could not be sampled. During the toxic pollutant survey, the Agency conducted another sampling visit at one of these plants and also visited two additional plants to increase the data base and to monitor for the presence of toxic pollutants. The results of these sampling visits (Plants 0060F, 0112D, and 0432A) demonstrate that significant quantities of toxic inorganic and organic pollutants are found in sintering wastewaters. Table III-2 summarizes the data base for sintering operations.

As with the originally promulgated effluent limitations and NSPS, the limitations and standards proposed herein are established on a unit process basis. Supporting this approach is the observation that all plants combine their various sintering process wastewaters for treatment. This system provides for the increased efficiencies of operation associated with the common treatment of various unit process wastewaters.

TABLE III-1

GENERAL SUMMARY TABLE
SINTERING

Plant Code	Air Pollution Equipment	Age-First Year of Prod.	Production-TPD Rated	Production-TPD 1976	Applied Flow* (gal/ton)	Disch. Flow* (gal/ton)	Treatment Compounds Process Treatment	Treatment Compounds Central Treatment	Operating Mode	Discharge Mode
0016A	No Longer In Operation									
0060	Wet & Dry	1975	2640	1875	[1667]	[219]		NW,SL Unk, FLL,FLP,FLO[1] CL,SS	RTP-70 RUP-10 REU-7	Direct
0060B	Wet & Dry	1958	2400	1647	2186	2186		PSP,CL,FLP, VF	RET-100	
0060F	Wet & Dry	1957	1360	1078	[301]	[26]	NL,FLL,CL	FLP,CL,VF SLURRY TO BFCL	RTP-91	Direct
0112	Dry Only	1930	6145							
0112A	Wet & Dry	1976	12,200	8260	[1604]	[288]		FLL,NL,CL,VF	RTP-82	Direct
0112B	Wet & Dry	1950	4000	3779	133	133		T,CL,VF	OT	Direct
0112C	Wet & Dry	1948	2683	2412	1292	793		CL,T,VF,NL	RTP-39	Direct
0112D	Wet & Dry	1975	6070	5100	[1432]	[142]	NL	NL,NW,NA,FLP, CL,SS,T, SL Unk,VF	RTP-90	Direct
0384A	Dry Only	1959		4000						
0396A	Wet & Dry	1959	3312	2642	[341]	[85]		VF,FLP,CL,CT	RTP-75	POTW
0432A	Wet & Dry	1960	6500	5856	[245]	[245]		SCR,PSP,FLP, T,CLA,VF	OT	Direct
0432C	Dry Only	1957	2500							
0448A	Wet & Dry	1943	3850	2325	Unk	0	SL(Unk) for sludge		RTP-100	
0492A	Wet & Dry	1947	1900	1072	2582	2582		SL(Unk)	RET-100	Direct
0584B	Dry Only	1958	4600							
0584C	Wet & Dry	1959	3800	2486	1368	1368		SS,SL(Unk), FDSP,CLB	OT	Direct

TABLE III-1
GENERAL SUMMARY TABLE
SINTERING
PAGE 2

Plant Code	Air Pollution Equipment	Age-First Year of Prod.	Production-TPD		Applied Flow gal/ton	Disch. Flow gal/ton	Treatment Compounds		Operating Mode	Discharge Mode
			Rated	1976			Process Treatment	Central Treatment		
0584F	Wet & Dry	1955	8187	4750	106	106	CL,VF,	T,FLP,VF	OT	Direct
0684B	Dry Only	1943	Unk							
0684I	Dry Only	1961	1500							
0856F	Wet & Dry	1956	7200	6711	[220]	[220]	T		OT	Direct
0856J	Dry Only	1959	15,000							
0856N	NONE	1948	1132							
0856Q	Wet & Dry Shut Down 1979	1949	500	616	2805	117	PSP,T	T,VF	RTP-96 RET-4	ES
0856T	Dry Only	1960	5000							
0860B	Dry Only	1950-58	16,600							
0860H	Dry Only	1958	5000							
0864A	Wet & Dry	1944	2910	1373	[2819]	[1733]	FLL,FLP,CL, SL(Unk)		RET-45 RTP-38	Direct
0868A	Dry Only**	1941	7783	6306	100	70	SL(Unk)		RTP-30	Direct & Quench
0920B	Wet & Dry	1966	1000	860	134	134		FLP,T,CL, FDC(Unk),VF	OT	Direct
0920F	Wet & Dry	1944	1500	1130	[2124]	[74]	NC,CL		RTP-4 RUP-90 RET-3	Direct
0946A	Wet Only	939	540	218	6605	6605		T,FLP,F(Unk) (Unk)P, CLA, VF	RET-30	Direct
0948A	Dry Only Inactive		2400							
0948C	Wet & Dry	1959	4000	3204	1124	135		BLOWDOWN TO BLAST FURNACE GAS SCRUBBING RECYCLE SYSTEM	RUP-88	-

TABLE III-1
GENERAL SUMMARY TABLE
SINTERING
PAGE 3

* : Presented in English units for convenience of industry and government accustomed to working with English units. Conversion to metric can be accomplished by multiplying by 4.17.

**: Wastewater generated at sinter quench station.

[ ]: The data enclosed in brackets represents information obtained during sampling visits or from D-DCP responses.

Legend

FLO$^{(1)}$: Flocculation with ferrousulfate.

NOTE: For definitions of the C&TT codes, refer to Table VII-1.

TABLE III-2

SINTERING DATA BASE

	Number of Plants	Percent of Total Number of Plants	Rated Plant Capacity (tons/year)	Percent of Total Annual Capacity
Plants sampled during the original guidelines survey	4	12.1	5,238,480	9.8
Plants sampled for the toxic pollutants survey	3*	9.1*	5,084,450	9.6
Plants which responded via D-DCP	5	15.2	9,654,250	18.1
Plants sampled and/or responding via D-DCP	11	33.3	17,604,680	33.1
"Wet" plants	20	57.1	30,599,775	57.8
Plants which responded to the DCP's**	33	100.0	53,221,380	100.0

---

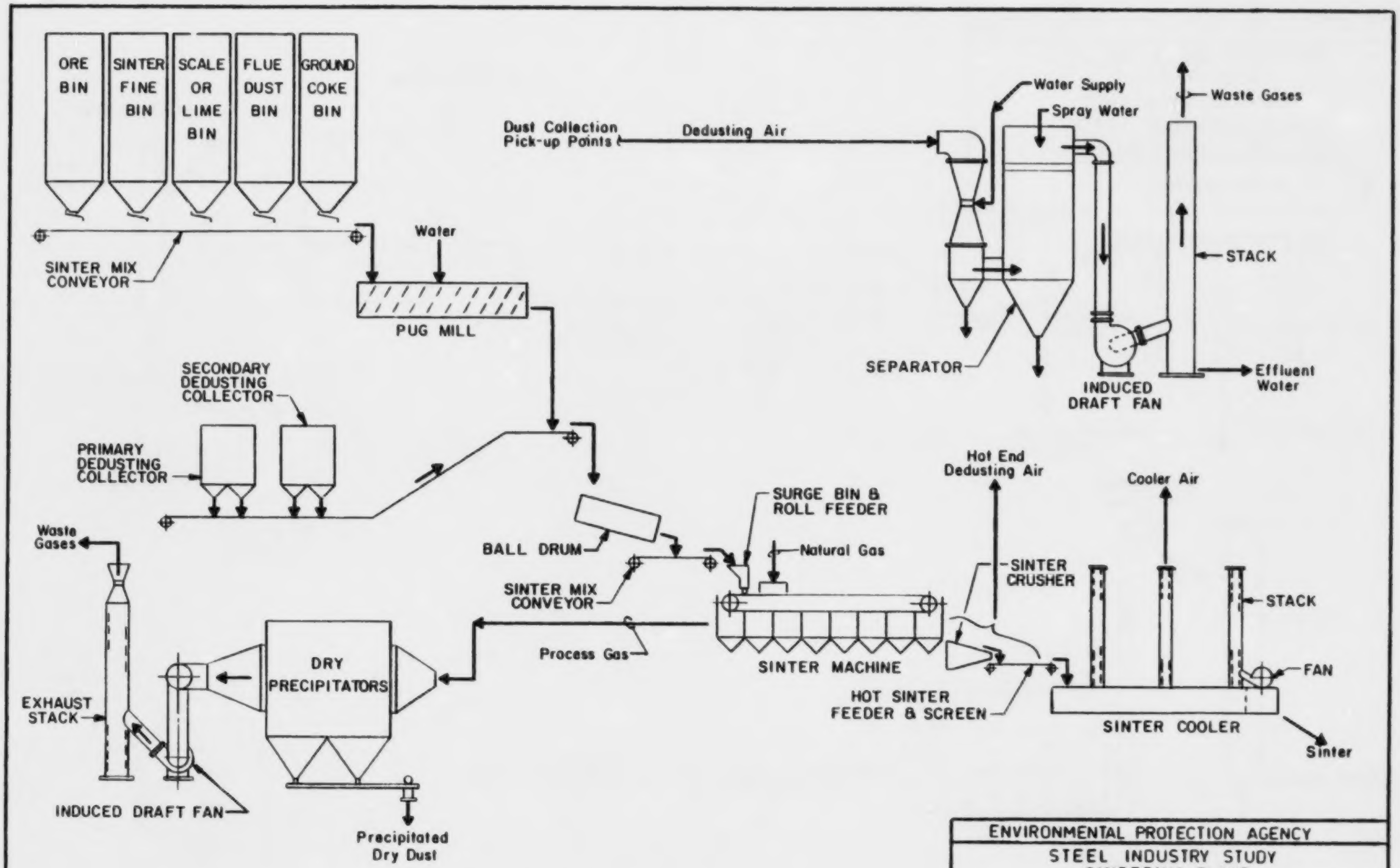
* : One plant sampled during original study was resampled.

**: Excludes the one confidential plant and the one plant no longer in operation.

TABLE III-3

SINTERING
RATED PRODUCTION CAPACITY (TONS/DAY)

	PLANT CODE	PRODUCTION CAPACITY
Plants generating a wastewater	0060	2,640
	0060B	2,400
	0060F	1,360
	0112A	12,200
	0112B	4,000
	0112C	2,683
	0112D	6,070
	0396A	3,312
	0432A	6,500
	0448A	3,850
	0492A	1,900
	0584C	3,800
	0584F	8,187
	0856F	7,200
	0856Q	500 (Shut Down 1979)
	0864A	2,910
	0868A	7,783
	0920B	1,000
	0920F	1,500
	0946A	540
	0948C	4,000
		83,835 SUBTOTAL
"Dry Plants	0112	6,145
	0384A	4,000
	0432C	2,500
	0584B	4,600
	0684B	Unk
	0684I	1,500
	0856J	15,000
	0856N	1,132
	0856T	5,000
	0860B	16,600
	0860H	5,000
	0948A	INACTIVE
		61,477 SUBTOTAL
		145,312 TOTAL

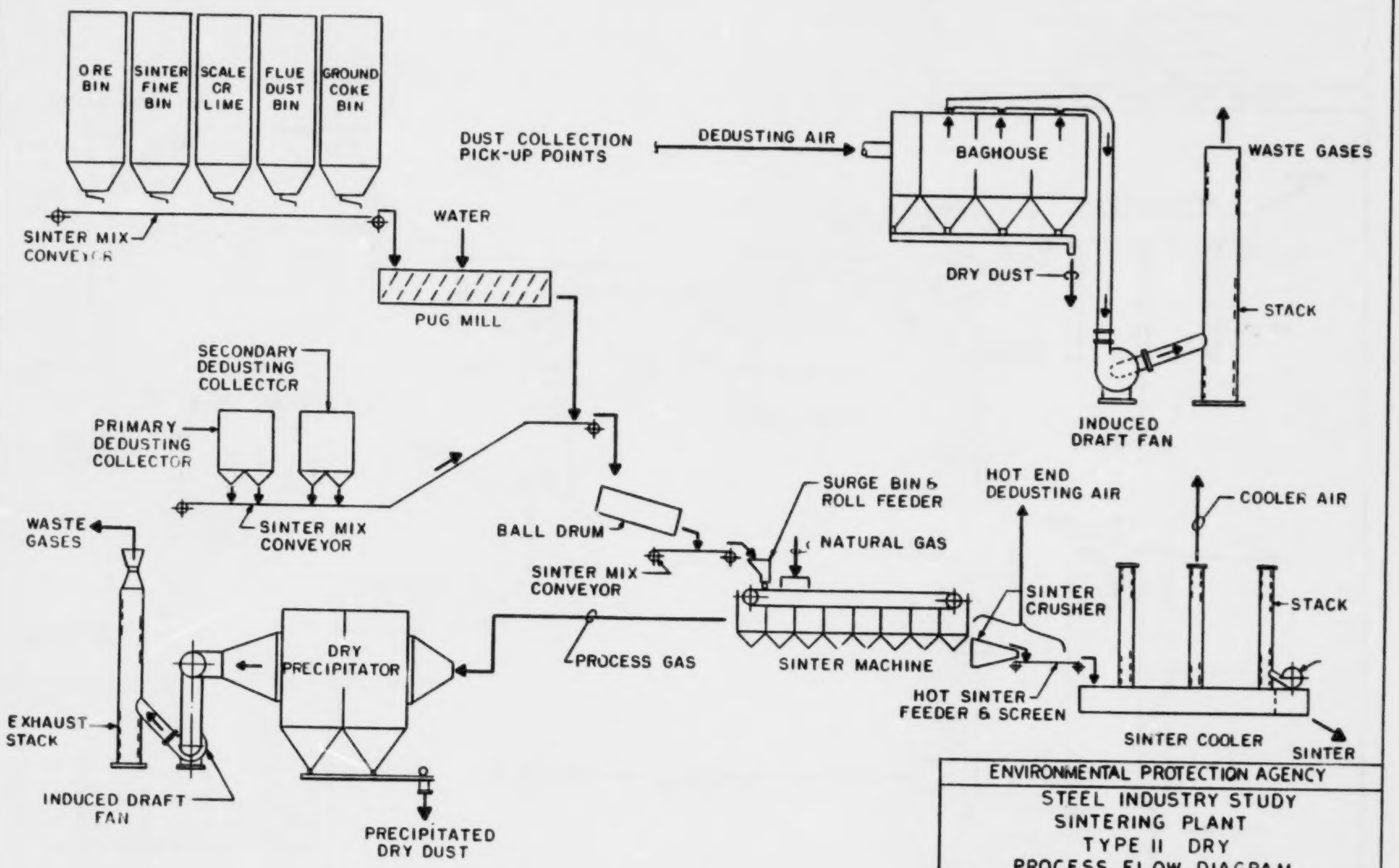

ORE BIN
SINTER FINE BIN
SCALE OR LIME BIN
FLUE DUST BIN
GROUND COKE BIN
SINTER MIX CONVEYOR
Water
PUG MILL
SECONDARY DEDUSTING COLLECTOR
PRIMARY DEDUSTING COLLECTOR
Waste Gases
EXHAUST STACK
INDUCED DRAFT FAN
DRY PRECIPITATORS
Precipitated Dry Dust
BALL DRUM
SINTER MIX CONVEYOR
Process Gas
SURGE BIN & ROLL FEEDER
Natural Gas
SINTER MACHINE
HOT SINTER FEEDER & SCREEN
SINTER CRUSHER
Hot End Dedusting Air
Cooler Air
STACK
FAN
SINTER COOLER
Sinter
Dust Collection Pick-up Points
Dedusting Air
Water Supply
Spray Water
SEPARATOR
INDUCED DRAFT FAN
STACK
Waste Gases
Effluent Water

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING PLANT
TYPE I-WET
PROCESS FLOW DIAGRAM

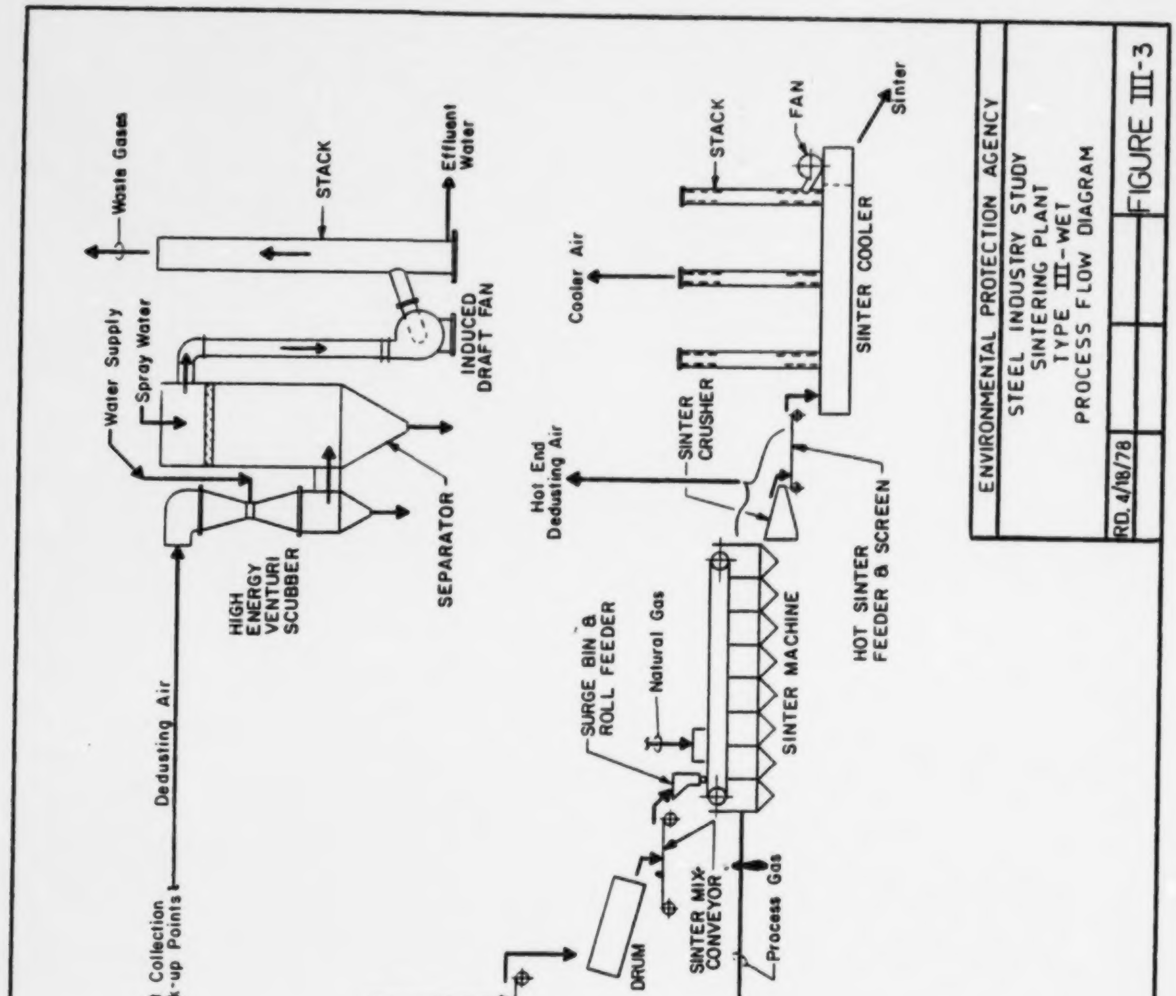
RD.4/17/78

FIGURE III-1


ORE BIN
SINTER FINE BIN
SCALE OR LIME
FLUE DUST BIN
GROUND COKE BIN
SINTER MIX CONVEYOR
WATER
PUG MILL
DUST COLLECTION PICK-UP POINTS
DEDUSTING AIR
BAGHOUSE
WASTE GASES
DRY DUST
STACK
INDUCED DRAFT FAN
SECONDARY DEDUSTING COLLECTOR
PRIMARY DEDUSTING COLLECTOR
SINTER MIX CONVEYOR
BALL DRUM
SURGE BIN & ROLL FEEDER
NATURAL GAS
HOT END DEDUSTING AIR
COOLER AIR
SINTER MIX CONVEYOR
SINTER CRUSHER
STACK
WASTE GASES
DRY PRECIPITATOR
PROCESS GAS
SINTER MACHINE
HOT SINTER FEEDER & SCREEN
SINTER COOLER
SINTER
EXHAUST STACK
INDUCED DRAFT FAN
PRECIPITATED DRY DUST

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
TYPE II DRY
PROCESS FLOW DIAGRAM
RD 4-17-78

FIGURE III-2


ORE BIN
SINTER FINE BIN
SCALE OR LIME BIN
FLUE DUST BIN
GROUND COKE BIN
Sinter Mix Conveyor
Water
PUG MILL
PRIMARY DEDUSTING COLLECTOR
SECONDARY DEDUSTING COLLECTOR
SINTER MIX CONVEYOR
BALL DRUM
SINTER MIX CONVEYOR
Process Gas
SURGE BIN & ROLL FEEDER
Natural Gas
SINTER MACHINE
HOT SINTER FEEDER & SCREEN
SINTER CRUSHER
Hot End Dedusting Air
SINTER COOLER
Cooler Air
STACK
FAN
Sinter
Dust Collection Pick-up Points
Dedusting Air
HIGH ENERGY VENTURI SCUBBER
SEPARATOR
Water Supply
Spray Water
INDUCED DRAFT FAN
STACK
Waste Gases
Effluent Water
Water Supply
HIGH ENERGY VENTURI SCRUBBER
SEPARATOR
Spray Water
INDUCED DRAFT FAN
STACK
Waste Gases
Effluent Water

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
TYPE III-WET
PROCESS FLOW DIAGRAM

RD. 4/18/78

FIGURE III-3

SINTERING SUBCATEGORY

SECTION IV

SUBCATEGORIZATION

The steelmaking segment of the steel industry is comprised of several separate and distinct processes. The Agency found that individual processes, products and wastewater characteristics affect industry subcategorization. Based upon a review of the factors mentioned above, the Agency has established sintering as an individual subcategory. Several factors were evaluated to determine if the sintering subcategory requires further subdivision. However, the Agency concludes that further subdivision is not warranted. The factors reviewed in reaching these conclusions are discussed below.

Manufacturing Process and Equipment

Sintering is unique in that it is the only process in which iron bearing fines (such as mill scale and flue dust from other steel operations) are mixed with other materials and combusted to form an agglomerate. The agglomerate, in turn, is used as a raw material for the ironmaking process. Because no other ironmaking or steelmaking process is similar, the Agency determined that the establishment of a sintering subcategory is appropriate.

Despite the various combinations of raw materials which are fed to the sintering operation, the process operation does not vary significantly from plant to plant. The basic process involves raw materials mixing, ignition and combustion, agglomeration of the sinter, and cooling and screening. The Agency determined that no further subdivision of this subcategory is warranted on the basis of manufacturing process differences.

Final Product

Sintering produces only one final product. This final product may vary in physical and chemical makeup among plants, but these differences are slight and of little importance to subdivision. The Agency determined that differences in final product do not warrant further subdivision of the sintering subcategory.

Raw Materials

Raw materials used in the sintering process consist of ores, mill scale, coke, limestone, slag fines and sludges (Table IV-1). The availability of these materials at each location determines the raw materials used at that facility. Although the composition of the raw materials may vary from plant to plant, the Agency found that these variations do not significantly affect process wastewaters. The model treatment systems evaluated by the Agency provide for effective control of the various sintering process wastewater pollutants.

Accordingly, the Agency concluded that these differences do not warrant further subdivision of this subcategory.

Wastewater Characteristics

Wastewaters generated at sintering operations result primarily from the scrubbing of the process gases and dusts. Although the nature of the wastewaters may vary as a result of their origin in the sintering process, similar pollutants are found in all sintering wastewaters. For example, oil and grease and suspended solids are common in all sintering wastewaters, as are cyanide, fluoride, sulfide, phenols, and various toxic metals. Although these pollutants may be found in varying levels, the range of concentrations and loadings are not so large as to warrant further subdivision. It is also important to note that plants with multiple sintering operation wastewater sources combined these wastewaters for treatment. Based upon the factors presented above, the Agency determined that further subdivision based on wastewater characteristics is not is warranted.

Wastewater Treatability

As noted for BPT, a concern in the treatment of sintering operation wastewaters is the removal of suspended solids, which in turn results in a reduction in the levels of those pollutants which comprise the suspended solids. This reduction in suspended solids is accomplished by using sedimentation technology. Except for one plant (which discharged to a blast furnace gas scrubbing recycle system), all plants have similar wastewater treatment systems. Accordingly, the Agency determined that further subdivision based upon wastewater treatability is not warranted.

Size and Age

The Agency considered the effect of size and age on the subdivision of sintering operations. Its analysis of the impact of size and age on such elements as wastewater generation, discharge flow rate (associated with the ability to recycle), and the ability to install treatment did not demonstrate a need for further subdivision.

The question of further subdivision on the basis of age was addressed by comparing plant age and discharge flow data. Discharge flow was used as an indication of wastewater treatment capability; e.g., did older plants meet the proposed BPT model flow. Figure IV-1 is a plot of discharge flow vs. plant age for all plants, while Figure IV-2 presents a plot of discharge flow vs. plant age for only those plants with treatment and recycle facilities. The low discharge flows exhibited at some of the oldest plants (representing the ability to provide adequate basic treatment) indicates that further subdivision of this subcategory on the basis of age is not appropriate. In addition, pollution control equipment can be retrofitted to exisitng plants as demonstrated by the plants noted on Table IV-2. For the eleven plants (55% of the "wet" sinter plants) listed on this table, the time span between the first year of production and the year of major water pollution control equipment installation varies from six years to thirty-three years.

The question of size was evaluated by comparing the rated capacity (size) of each plant with its discharge flow. Figure IV-3 presents a plot of discharge flow vs. plant rated production capacity for all plants, while Figure IV-4 presents a plot of discharge flow vs. plant rated production capacity for only those plants with treatment and recycle facilities. The distribution of the data meeting or exceeding the BPT model flow indicates that plant size does not affect the ability to provide wastewater treatment. The points are widely distributed from small to large plants. Therefore, the Agency determined that further subdivision on the basis of size is not warranted.

Geographic Location

Most of the sinter plants are located in the east and midwest. Only one plant (which recycled a portion of its process wastewaters) is located in either an arid or semi-arid region. Most plants employ wastewater recirculation as an integral part of treatment. These plants are not restricted on the basis of geographic location. Accordingly, the Agency concluded that further subdivision on the basis of geographic location is not warranted.

Process Water Usage

Process water usage varies from plant to plant depending primarily upon the type and number of "wet" scrubbers in use. However, wastewater quality for all operations is similar and all wastewaters from each plant are combined for treatment. In addition, low discharge flows from the sintering operations are achieved by plants having both high and low applied flow rates. Hence, the Agency concluded that further subdivision based upon process water usage rates is not warranted.

TABLE IV-1

RAW MATERIALS SUMMARY FOR SINTERING OPERATIONS GENERATING WASTEWATERS

(All numbers represent the percent of total raw material feed)

			IRON SOURCES		
PLANT NO.	FUEL(1)	FLUXES(2)	ORES(3)	IRON BEARING(4) MATERIALS	ALL IRON SOURCES
0060	3.9	22.0	33.5	40.6	74.0
0060B	2.2	20.7	25.1	52.1	77.1
0060F	2.0	15.5	24.4	58.0	82.5
0112A	4.9	18.0	70.2	6.9	77.1
0112B	5.0	20.0	45.0	30.0	75.0
0112C	4.6	17.5	63.0	14.9	77.9
0112D	2.6	15.6	39.5	42.3	81.8
0396A	4.3	22.6	67.5	5.6	73.1
0432A	4.1	28.7	53.8	13.4	67.2
0448A	5.0	18.6	72.9	3.4	76.4
0492A	4.1	16.9	60.4	18.6	79.0
0584C	7.0	19.0	46.0	28.0	74.0
0584F	9.0	32.5	50.7	7.8	58.5
0856F	6.0	17.0	58.0	19.0	77.0
0856Q*	5.6	-	76.0	18.5	94.4
0864A	6.2	11.8	75.9	6.0	82.0
0868A	5.7	15.8	75.1	3.4	78.5
0920B	13.2	24.9	29.6	32.4	61.9
0920F	-	26.4	37.0	36.7	73.6
0946A	3.0	-	50.6	46.4	97.0
0948C	3.9	35.7	43.0	17.5	60.4

---

(1) Includes coke and coke breeze.
(2) Includes limestones, dolomite, sand, stone fines, calcined fines, etc.
(3) Includes iron ore, ore fines, pellet fines, taconite fines, etc.
(4) Includes mill scale, flue dust, metallic fines, sludges, filter cakes, slags, sinter, etc.
*: Shut down 1979.

TABLE IV-2

EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE ABILITY TO RETROFIT WATER POLLUTION CONTROL EQUIPMENT SINTERING SUBCATEGORY

Plant Reference Code	Plant Age - First Year of Production	Treatment Age - Year of Installation Major Components
0060B	1958	1968
0060F	1957	1975
0112B	1950	1970
0112C	1948	1960
0448A	1943	1971
0548C	1959	1965
0584C	1959	1965
0864A	1944	1962
0868A	1941	1954
0920F	1944	1973
0946A	1939	1972

FIGURE IV-1
DISCHARGE FLOW vs. PLANT AGE
SINTERING

ALL MILLS

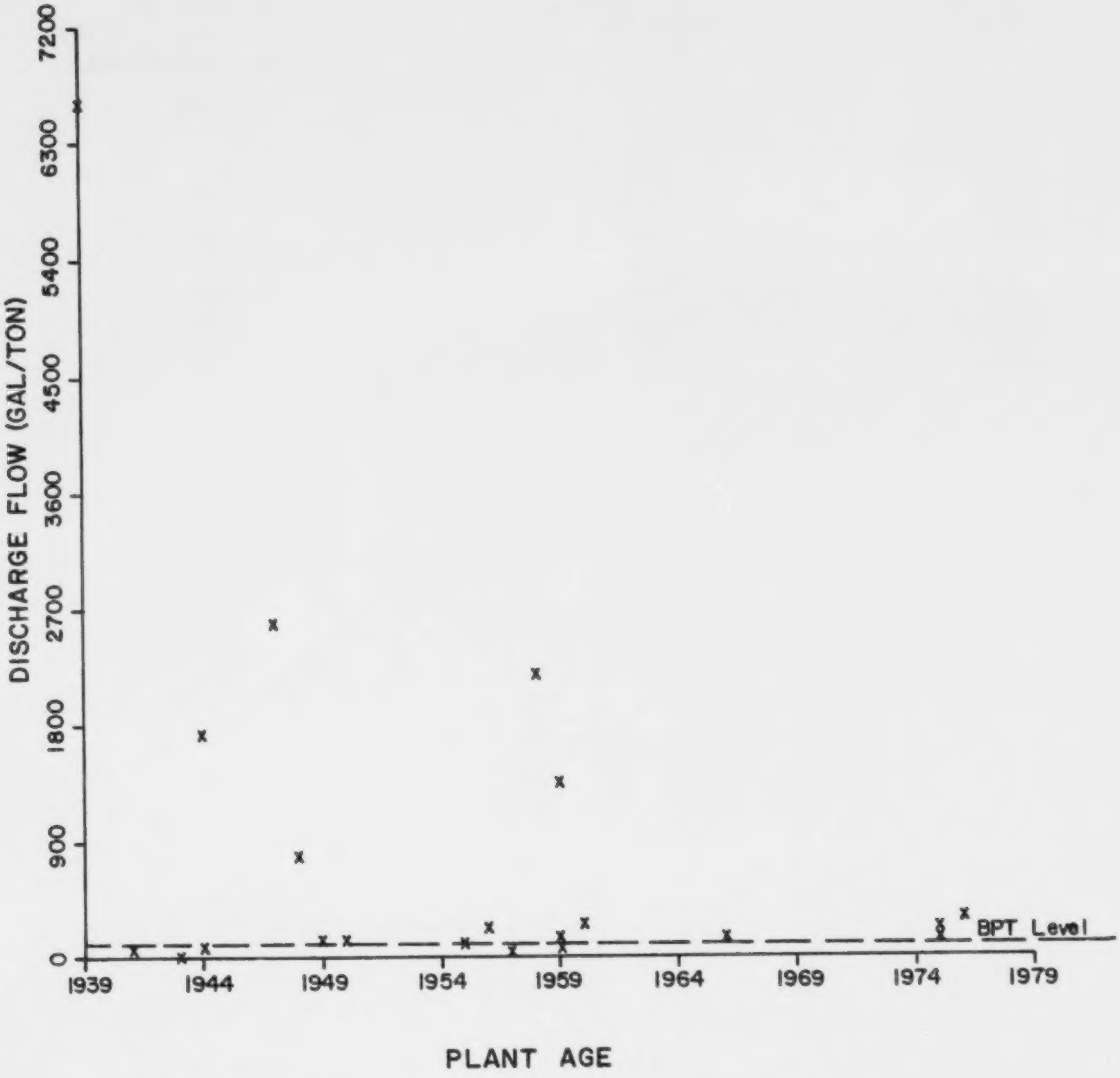


FIGURE IV-2
DISCHARGE FLOW vs. PLANT AGE
SINTERING

MILLS THAT RECYCLE

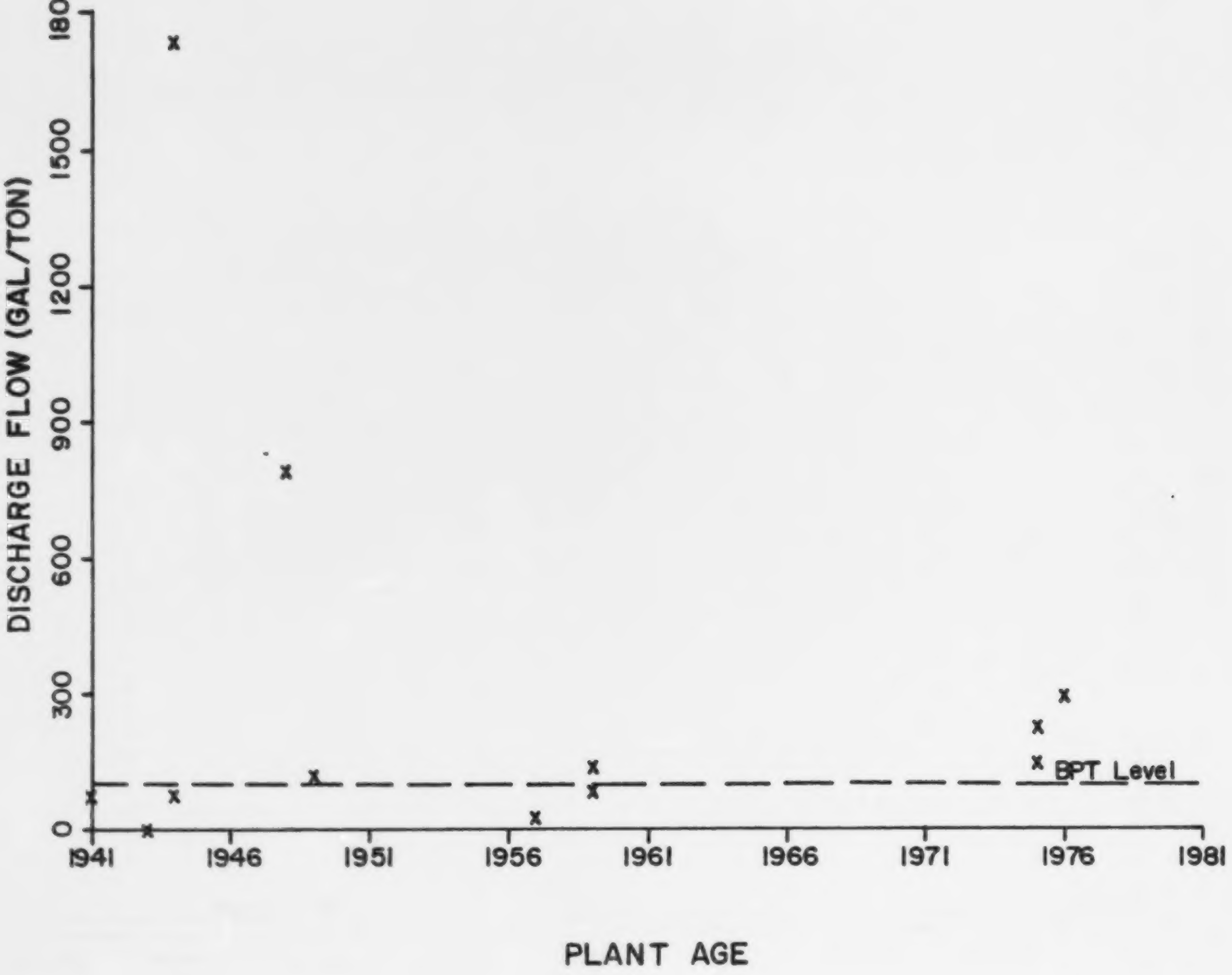


FIGURE IV-3
DISCHARGE FLOW vs. PLANT RATED PRODUCTION CAPACITY
SINTERING

ALL MILLS

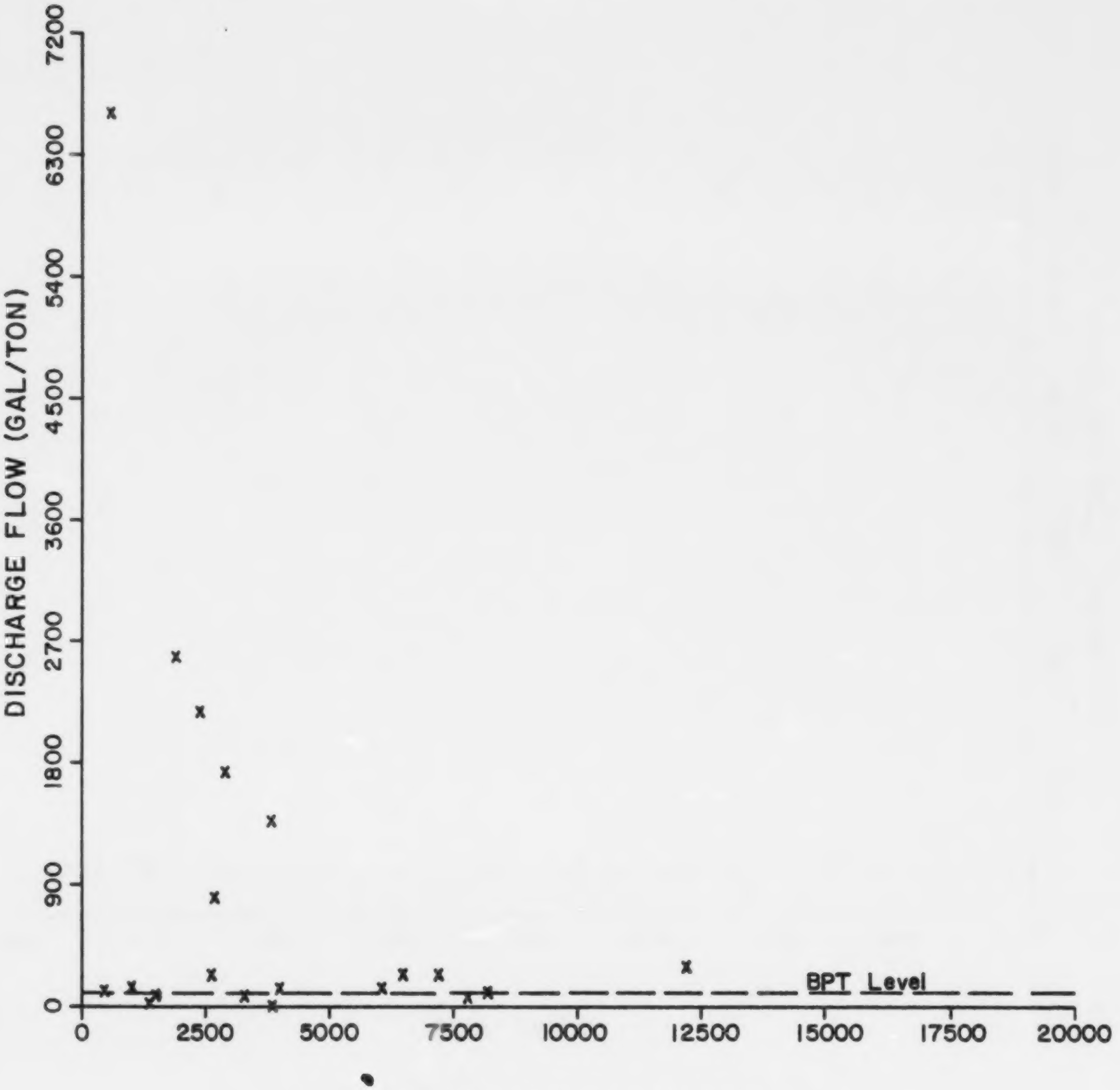
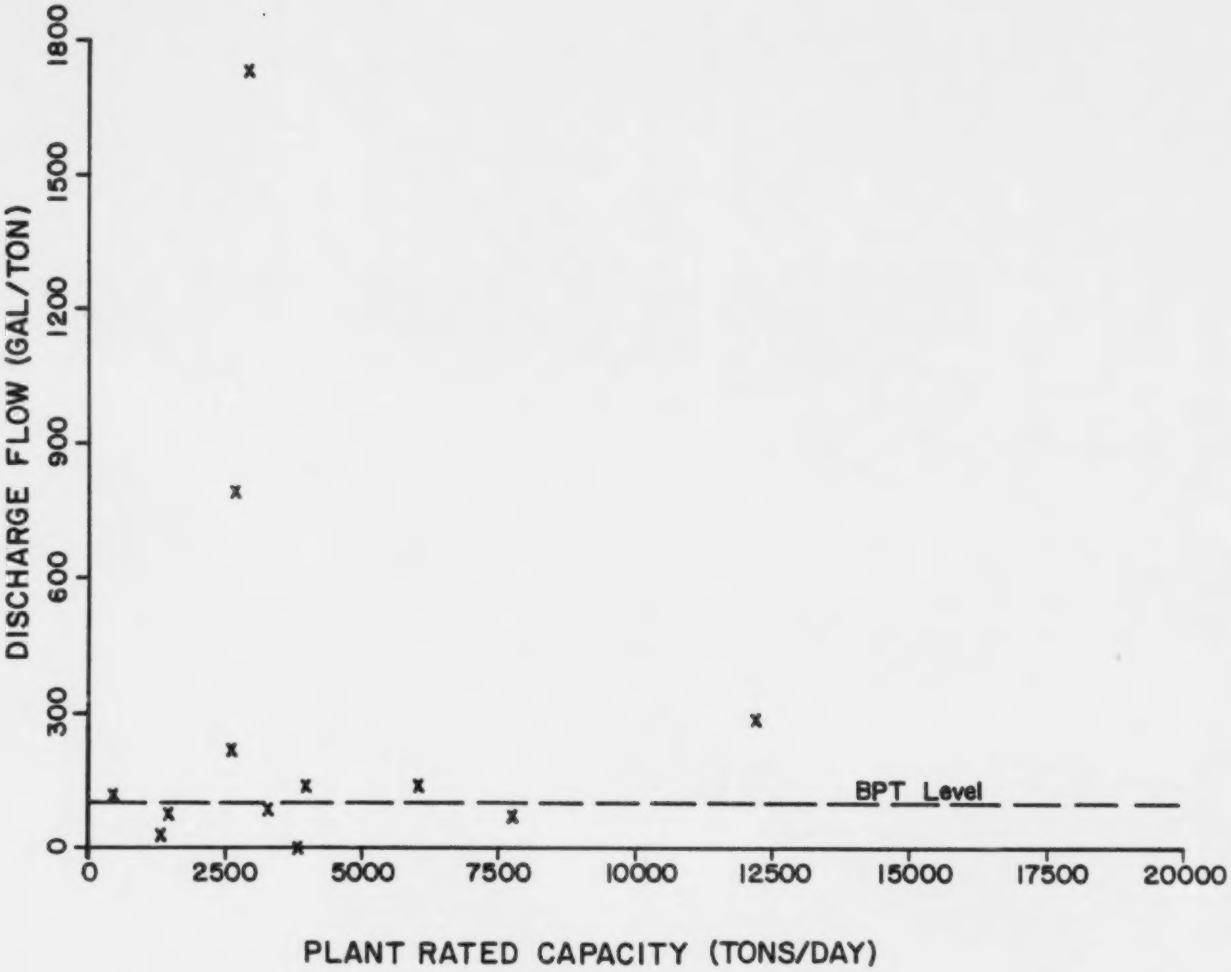


FIGURE IV-4
DISCHARGE FLOW vs. PLANT RATED PRODUCTION CAPACITY
SINTERING

MILLS THAT RECYCLE



SINTERING SUBCATEGORY

SECTION V

WATER USE AND WASTE CHARACTERIZATION

Introduction

Process water usage is a significant factor in determining the pollutant loads and in estimating the cost of removing those pollutants generated by sintering operations. The importance of carefully controlling process water usage cannot be overemphasized. The Agency used data from the sampling visits and the DCPs to evaluate process water use, pollutant discharges, total wastewater volumes, and to identify existing control and treatment technology.

Wastewater characterization is based upon data obtained during the field sampling programs. During the original guidelines survey, the Agency investigated the levels of limited pollutants (suspended solids, oil and grease and pH) in the process wastewaters. During the second field sampling program, the Agency again investigated the levels of the previously limited pollutants and performed additional monitoring and analyses for toxic inorganic and organic pollutants.

The water use rates discussed below pertain only to process wastewaters. Noncontact cooling or nonprocess waters are not included. Process wastewaters are those waters which come into direct contact with the process, product, by-products, or raw materials. Noncontact cooling waters are cooling waters which do not directly contact the processes, products, by-products, or raw materials. Nonprocess waters are those waters which are used for nonprocess operations, i.e., utility and maintenance department requirements.

Description of Sinter Plant Wastewater Sources

As noted earlier, sintering process wastewaters result from dust and gas scrubbing equipment and from sinter cooling and quenching. Newer plants typically use "dry" air pollution equipment while the older plants typically have "wet" systems. Sinter plant gas and dust scrubbing equipment is generally separated into two systems. One of the systems scrubs the fumes and dusts from the hot sinter bed, ignition furnace, and sinter bed wind boxes, while the other system controls emissions from the sinter crushers, sinter fines conveyors, raw material storage bins, and feeders. As can be noted in Table III-1, however, common industry practice is to combine the various wastewater streams for treatment.

Industry responses to the DCPs provided process wastewater and treated effluent flow data. In many instances the flow rates were reported as measured values, but in other instances the flows were reported as design rates or rates based upon best engineering judgment. Where available, plant visit or D-DCP flow data were included in Table III-1 in lieu of DCP data.

Raw process wastewater flows ranged from 417 l/kkg (100 gallons/ton) of sintered product to 27543 l/kkg (6605 gallons/ton). The lowest flow was observed at a plant with strictly dry air pollution equipment, which generated a small amount of wastewater during sinter cooling. Other plants exhibited similar process wastewater flows (e.g., 106, 133 and 134 gal/ton). Two of these plants have as many as four scrubbers.

Plant effluent flows also varied over a wide range, i.e., 108 l/kkg (26 gallons/ton) to 27543 l/kkg (6605 gallons/ton). The lowest effluent flow was observed at a plant which discharges only a thickener underflow. In this system, the thickener overflow is completely recycled. The wide range in flows can be attributed to several factors, but the number of scrubbers and the scrubber design and efficiency primarily dictate water usage rates.

One method of conserving water and reducing the quantities of discharged pollutants is the recirculation of partially treated wastewaters. Wastewater recirculation is currently practiced at 11 sinter plants and is a major component of the BPT model treatment system. Although wastewater recirculation can result in increased levels of certain pollutants in recycled wastewaters, the significant reduction in total discharge flow results in an overall reduction in discharged pollutant loads.

Sintering wastewaters contain large quantities of suspended particulate matter and oil and grease. In addition, toxic inorganic and organic pollutants and fluoride were found in sintering wastewaters at significant levels. The concentration data presented in Table V-1 provide a measure of the pollutant loads contributed during each pass through the process, thereby indicating which pollutants are significant with respect to sintering operations. After reviewing the raw waste and treated effluent levels of pollutants and the degree of recycling, the Agency determined that the effect of makeup water quality on the discharge is negligible. Accordingly, the Agency has decided to propose effluent limitations and standards which are based solely on gross values.

TABLE V-1

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES AND TOXIC POLLUTANT SURVEYS
SINTERING

Pick-up per Pass Concentrations in Raw Process Wastewaters*

	Reference Code:	0432A	0396A	0112D	0432A	0060F
	Plant Code:	H	J	016	017	019
	Sample Point(s):	-	(1-Sludge)-(4+2)	(B+C)-(E+A)	D+E-A	B-(C+A)
	Flow, gal/ton:	-	341	1432	245	301
		mg/l	mg/l	mg/l	mg/l	mg/l
	Oil and Grease	ISD**	387	17.4	ISD	197
	Suspended Solids	ISD**	19,460	82	5356	746
	Fluoride		1.22	24	6.2	18
	Sulfide		74.5	ISD	ISD	0.2
39	Fluoranthene			0.031	0.003	-
59	2,4-Dinitrophenol			0.014	ND	ND
65	Phenol			0.007	-	0.557
72	Benzo(a)anthracene			0.015	-	-
73	Benzo(a)pyrene			0.023	0.003	-
76	Chrysene			0.041	-	-
84	Pyrene			0.029	0.006	-
118	Cadmium			0.005	ISD	$0.115^{(D)}$
119	Chromium			0.008	0.496	$0^{(D)}$
120	Copper			0.053	0.059	$0.142^{(D)}$
121	Cyanides			-	0.041	0.177
122	Lead			0.541	ISD	ISD
124	Nickel			-	ISD	$0.016^{(D)}$
126	Silver			0	ISD	$-^{(D)}$
128	Zinc			0.043	0.850	$-^{(D)}$
	Phenolic Compounds			0.131	0.050	0.06

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* : Only those toxic pollutants found in concentrations greater than 0.010 mg/l are presented.
** : No makeup water sample was obtained
ISD: Insufficient data to complete the evaluation
- : Calculation results in a negative value
ND : Not Detected
D : Dissolved

SINTERING SUBCATEGORY

SECTION VI

WASTEWATER POLLUTANTS

Introduction

A review of pollutants specific to the steel industry and the general strategy for selecting pollutants for which limitations are proposed are presented in Volume I. The selection of limited pollutants for the sintering subcategory was based upon this process and on other factors pertaining to the sintering process and sintering wastewaters.

Rationale for Selection of Pollutants

The pollutants which the Agency found in sintering process wastewaters reflect the variety of sintering process raw materials (e.g., iron and steelmaking flue dust, ores, mill scale, coke, limestone, slag fines, and blast furnace thickener sludges). Fines and dust from all sources contribute to the suspended solids loadings. Oil and grease is present primarily as a result of the oils and greases carried into the process by the scrap and mill scales. Compounds detected in the oil and grease analysis can also result from the incomplete combustion of coke in the sintering process. The presence of fluoride is attributable to the use of lime fluxing agents and slag fines in sintering operations.

Particulates generated during the sintering process are transported in the process gases, and are removed by scrubbing with water. The solids found in the process wastewaters are comprised of a variety of chemical constituents including various toxic pollutants. The removal of the suspended solids therefore results in the removal, to varying degrees, of a number of other pollutants (e.g., metals). Other pollutants (i.e., chloride, sulfate) are present at substanital levels in the process wastewaters, but are not included in the list of selected pollutants since they are nontoxic and difficult to remove. Treatment for these pollutants is not commonly practiced in the wastewater treatment operations of any industry.

The toxic organic and inorganic pollutants are attributable to the raw materials used in the sintering process. Although the Agency detected phthalate compounds (e.g., butyl benzyl phthalate, di-n-butyl phthalate and di-n-octyl phthalate), it believes that their presence is due to sampling and analytical procedures. An evaluation of process conditions and operations provided no indication that phthalates are generated directly as a result of sinter production. Hence, Table VI-2 does not include all of the toxic organic pollutants listed in Table VI-1. The toxic metal pollutants found in the wastewaters originate in the iron bearing material charged to the sinter machine. These pollutants contaminate the process wastewaters mainly as a result of scrubbing the particulates from the process gases.

This study also considered the levels of the other toxic pollutants. Initially, all pollutants classified as "known to be present" were included in the list of pollutants for the sintering process. The above classification was developed on the basis of responses to the DCPs, and analyses completed during the screening phase of the project. Table VI-1 lists these pollutants.

The Agency calculated a net concentration (reflecting the pollutant pickup per pass through the process as described in Section V) for each pollutant detected in the raw wastewaters at 0.010 mg/l or greater. Those pollutants found at an average net concentration of less than 0.010 mg/l were excluded from further consideration in the selection process. The list of selected pollutants is presented in Table VI-2. The Agency established effluent limitations on a gross basis only (see Section V).

TABLE VI-1

TOXIC POLLUTANTS KNOWN TO BE PRESENT SINTERING OPERATIONS

4	Benzene
23	Chloroform
39	Fluoranthene
59	2,4-Dinitrophenol
65	Phenol
72	Benzo(a)anthracene
73	Benzo(a)pyrene
76	Chrysene
84	Pyrene
85	Tetrachloroethylene
86	Toluene
115	Arsenic
118	Cadmium
119	Chromium
120	Copper
121	Cyanide
122	Lead
123	Mercury
124	Nickel
125	Selenium
126	Silver
127	Thallium
128	Zinc

TABLE VI-2

SELECTED WASTEWATER POLLUTANTS
SINTERING

	Phenols (4AAP)
	Fluoride
	Suspended Solids
	Oil and Grease
	pH
39	Fluoranthene
65	Phenol
76	Chrysene
84	Pyrene
118	Cadmium
119	Chromium
120	Copper
121	Cyanide (Total)
122	Lead
124	Nickel
126	Silver
128	Zinc

SINTERING SUBCATEGORY

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Introduction

The model treatment systems for BPT, BAT, BCT, NSPS, PSES, and PSNS were established after determining current wastewater treatment practices in the industry. The various treatment technologies were formulated as "add-ons" to a primary level of treatment. Effluent limitations were established on the basis of effluent analytical data obtained during plant visits, D-DCP long-term analytical data, and the demonstrated capabilities of certain technologies. Treatment system summaries, schematics and wastewater analytical data for the visited plants are presented below.

Control and Treatment Technology - Sintering Operations

Most sintering wastewater treatment facilities currently provide treatment for suspended solids, although removal of other pollutants occurs incidentally. A summary of treatment practices noted during plant visits and reported in the DCPs follows.

a. Wastewaters from twelve of the twenty "wet"sintering plants are treated in central treatment facilities. Five plants have separate treatment facilities which discharge directly to navigable waters, while three plants discharge the effluent from separate treatment facilities to central treatment systems. In almost all instances, the central treatment systems receive only ironmaking and sintering wastewaters. Treatment facilities at the eight sintering plants with separate treatment systems are similar in design to the central treatment facilities. An evaluation of data from separate and central treatment systems indicates that similar flow rates, recycle rates, and effluent levels are achieved with either system. Treatment models presented herein are for separate treatment facilities, thus overstating treatment plant costs where central or co-treatment is practiced. Central treatment tends to decrease overall treatment costs. Table VII-2 presents a summary of pertinent data for plants discharging to central treatment facilities.

b. Sedimentation is the primary wastewater treatment technology applied to sintering operation wastewaters. Of the 20 sinter plants, sixteen use thickeners or clarifiers and four use settling lagoons. At eleven of the sixteen plants with thickeners, the sludges removed from the bottom of the thickener are pumped to vacuum filters which are used to dewater the sludges. At several plants, the dewatered solids are returned to the sintering operations to recover iron values. The filtrate is returned to the thickener influent and the thickener effluent is either discharged or recycled. Five plants discharge treated wastewaters to other steel plant operations for reuse.

c. In order to enhance solids removal, various coagulant aids (principally polymeric flocculants) are added to the wastewaters prior to settling. The polymeric flocculants (in use at ten plants) help to form larger, more readily settleable particles. A certain degree of toxic inorganic and organic pollutant removal accompanies the solids removal accomplished by sedimentation.

d. As mentioned above, five plants discharge treated wastewaters for reuse in other steel plant operations. Wastewater treatment at four of the five plants is provided at a central treatment facility. Also, treated effluent from four of the five plants is reused as make-up for blast furnace coolers and scrubbers. The effluent from one central treatment facility is reused at many other operations. In some of these systems, sinter process wastewater pollutants are diluted, rather than effectively treated.

e. Recycle of treated process wastewaters is practiced at twelve plants. Eight of these plants (five of which have separate treatment facilities) recycle treated effluents at rates varying from 30% to 100%. Three plants (one of which has a separate treatment facility) recycle both untreated and treated wastewaters at rates varying from 77% to 94%. The remaining plant recycles only untreated wastewaters at a rate of 88%. The basic recycle system includes sedimentation with vacuum filtration for sludge dewatering. Flocculating agents are used to enhance solids removal capabilities in some systems.

f. Alkaline chlorination is used at two plants to control cyanide. In both instances, sinter plant wastewaters are treated with blast furnace wastewaters in central treatment systems.

g. Three plants (in which the sintering wastewaters comprise a small portion of the total treatment volume) use filters for additional suspended solids removal. Blast furnace, BOF, or steel finishing wastewaters are the major wastewater sources in each of these systems.

h. One plant discharges the blowdown from a treatment and recycle system to a publicly owned treatment works (POTW). Sintering wastewaters make up 76% of the volume.

Control and Treatment Technologies Considered for Toxic Pollutant Removal

As the Agency found toxic inorganic and organic pollutants above treatability levels in sintering wastewaters, it is proposing BAT effluent limitations and NSPS, PSES, and PSNS.

Although compliance with the proposed BPT effluent limitations results in toxic pollutant removal incidental to the reduction in effluent volume and suspended solids, the Agency believes that toxic pollutant removal at that level is insufficient. Several toxic pollutants were present in concentrations greater than 0.5 mg/l in the effluents of the sampled plant treatment facilities.

The treatment technologies which the Agency has considered for sintering wastewaters are described below. BAT, NSPS, PSES, and PSNS levels of treatment are reviewed in detail in subsequent sections.

a. Filtration

Filtration technology is generally used to further reduce the discharge of suspended solids. However, filtration can be used to control toxic pollutants which are entrained in the suspended solids. Filtration can be used as the last major component in a treatment system or to provide a polished feed stream to another treatment operation such as adsorption on activated carbon. Particulate pollutant removal is accomplished by passing the wastewater stream, either under pressure or by gravity, through a filter media. The filter media, generally sand, anthracite coal and/or garnet, permits water to pass through but prevents the passage of much of the particulate matter suspended in the wastewater. The filter media itself may be comprised of a single type and size of media, various sizes of the same type of media, or a mixed media which contains several types and sizes of media.

b. Alkaline Chlorination

The Agency considered alkaline chlorination technology for the treatment of sintering wastewaters based upon the use of this technology at several sinter plants in which co-treatment with blast furnace wastewaters is provided. The primary purpose of alkaline chlorination is to reduce the levels of cyanide in the wastewaters. However, it is also effective in oxidizing phenolics, other toxic organic pollutants, and ammonia-N.

Alkaline chlorination is a process in which cyanide is destroyed (oxidized) as a result of chemical oxidation. The reaction occurs as a result of the introduction of chlorine, an oxidizing agent, to wastewaters which already have or which have been adjusted to an alkaline pH. Lime or caustic can be used for pH adjustment, although in most instances lime addition is a less expensive system. Cyanide oxidation involves two basic reactions: the oxidation of cyanide to cyanate at a pH greater than 10, immediately followed by the further oxidation of the cyanate to carbon dioxide and nitrogen at a pH of 8.0-8.5. Cyanogen chloride is an intermediate product of the oxidation of cyanide to cyanate. Care must be taken to maintain wastewater pH greater than 10 in order to prevent the evolution of the toxic cyanogen chloride gas and to insure rapid and complete cyanide oxidation. It must be noted that chlorine comsumption will be in excess of that predicted strictly on the basis of cyanide oxidation requirements due to the presence of other oxidizable pollutants. Chlorine can be added either in the gaseous state, through a chlorinator, or as a liquid (sodium hypochlorite).

Electrodes which measure the wastewater oxidation-reduction potential (ORP) can be used to control the chlorine feed to insure complete cyanide destruction. ORP is an electrochemical measurement, expressed as positive or negative millivolts, which can be used to determine the direction and rate of various oxidation or reduction reactions. In this application, the ORP would be maintained at a point indicative of rapid and essentially complete cyanide oxidation.

The effectiveness of this technology is reviewed in more detail in the ironmaking subcategory report with sampled plant, long-term, and pilot plant analytical data. The data presented also demonstrate that, with proper process design and operation, this technology does not produce an adverse impact due to the formation of chlorinated hydrocarbons. Pilot plant studies at plant 0860B indicate that chlorinated hydrocarbon formation is small. Data from additional ironmaking wastewater treatment pilot plant studies also show negligible chlorinated hydrocarbon formation, while low levels of brominated compounds were generated. Sinter plant wastewaters are similar in composition to blast furnace wastewaters (both contain cyanide, phenols, and toxic metals). As a result, the application of alkaline chlorination to either waste stream should produce similar effluent quality. As noted previously, alkaline chlorination is, in fact, applied to the combined sinter and blast furnace wastewaters.

c. Dechlorination

To minimize the potential toxicity of wastewaters which have undergone chlorination, the Agency considered dechlorination as a treatment method to reduce total residual chlorine levels in the treated discharge. Existing wastewater treatment practices in this subcategory are uniformly inadequate for dechlorination purposes. This technology is widely practiced in the electric power generation and electroplating industries. As one of the final treatment steps, dechlorination is generally effective on wastewaters generated by various sources. The Agency therefore believes that it is equally effective when applied to sintering wastewaters. Reducing agents, such as sulfites and sulfur dioxide are added to the chlorinated effluent in sufficient quantities to react with the excess residual chlorine, thereby forming nontoxic chlorides. This technology is considered a part of a total alkaline chlorination system.

d. Sulfide Precipitation

The addition of sulfide compounds in a wastewater treatment process may result in a more efficient level of toxic metals removal than can be achieved with typical lime flocculation, precipitation or sedimentation procedures. Some of the metals which can be effectively precipitated with sulfide are zinc, copper, nickel, lead and silver, all of which are found in sintering wastewaters. The increased removal efficiencies are attributable to the relative solubilities of metal hydroxides and metal sulfides. In general, the metal sulfides are less soluble than the respective metal hydroxides. It must be noted, however, that an excess of sulfide in a treated effluent may result in objectionable odor problems, especially if the pH is less than 7. One method of controlling the excess feeding of sulfide involves the addition of a ferrous sulfide slurry. As ferrous sulfide will not readily dissociate in the waste stream the free sulfide level is kept well below objectionable limits. However, since the affinities of the other metals for sulfide are greater than that of iron, the other metal sulfide precipitates are formed preferentially to iron sulfide. Once the sulfide requirements for the other metal precipitates is satisfied, the remaining sulfide remains in the ferrous sulfide form and the excess iron from the ferrous sulfide is precipitated as a hydroxide. Sedimentation following sulfide addition can thus result in significant toxic metal reductions, and, when used in conjunction with filtration, even greater reductions can be achieved. When used in conjunction with alkaline chlorination, sulfide addition will also consume excess chlorine following oxidation.

e. Removal of Organics with Activated Carbon

Activated carbon has been used in many applications for the removal of toxic organics pollutants from wastewater streams. One of the more frequent uses is the reduction of COD and BOD concentrations in the effluent from sanitary treatment systems. Activated carbon is also used to remove toxic organic pollutants from wastewaters of various industrial operations, including petroleum refining, organic chemicals, and cokemaking. Several toxic organic pollutants found in sintering wastewaters are also found in cokemaking wastewaters. This can be attributed to the use of coke in the sintering operation.

Operational guidelines for the use of activated carbon specify that where treatment of combined waste streams is involved or where the water to be processed has significant turbidity, preliminary treatment by clarification followed by filtration is required to achieve optimum organics removal. The use of chemical precipitation and diatomaceous earth filtration is sometimes required to achieve the clarity required for the removal of pollutants present at low levels. Particulates in wastewaters can adsorb organics and then release these organics after passage through the carbon bed.

Laboratory tests performed on single compound systems indicate that processing with activated carbon will achieve residual levels on the order of 1 microgram per liter for many of the organic compounds on the toxic pollutant list. Compounds which respond well to adsorption include chlorinated phenols, phenols, nitrophenols, and polynuclear aromatics.

Control of pH in the neutral range is necessary to minimize dissociation of both acid and basic organic compounds. As a general rule, normal pH variations within the neutral range will not significantly affect the operation of activated carbon columns. It may also be noted that it may be impractical (as well as extremely expensive) to have two carbon adsorption systems in series, one operating at a low pH and the other at a high pH.

Data for existing industrial wastewater treatment applications indicate that activated carbon adsorption technology is transferrable to the treatment of sintering wastewaters. Refer to Sections VII and X of the ironmaking subcategory report and to Volume I for details regarding the capabilities of this technology. For specific details pertaining to sintering process wastewaters, refer to the pilot study data presented in the ironmaking report. Since sintering and ironmaking wastewaters are similar and are often treated together, pilot plant data for treatment of ironmaking wastewaters can be applied to the development of effluent limitations for sintering operations, as well as for ironmaking operations.

Plant Visit Analytical Data

Table VII-1 presents the definitions for the various control and treatment technology and operating mode abbreviations. Table VII-3 presents a summary of raw wastewater data from sintering operations visited during both the original guidelines and toxic pollutant surveys. Table VII-4 presents a summary of effluent data from sintering operations visited during both the original guidelines and toxic pollutant surveys. Table VII-5 presents a summary of long-term effluent analytical data provided in response to the D-DCPs.

Plant Visits

The Agency sampled the wastewaters from seven sintering plants to supplement data obtained in the original guidelines study. Since complete data could not be obtained from three of the plants visited during the original guidelines survey, the limited data were of little value in determining wastewater treatment performance in these instances. A brief description of each of the visited plants is presented below. Schematic diagrams of the respective treatment facilities are presented at the end of this section.

Plant H - Figure VII-1

Wastewaters from the sinter plant are mixed with wastewaters from the blast furnace and other sources, and then treated for solids removal with polymer addition and sedimentation in thickeners. The thickener overflow is discharged to a receiving stream, while the underflow is dewatered with vacuum filters.

Plant I - Figure VII-2

Wastewaters from the sinter plant are mixed with blast furnace wastewaters and treated in a thickener to remove suspended solids. The thickener underflow is vacuum filtered, with the filtrate being returned to the thickener. The thickener overflow undergoes further treatment including alkaline chlorination and filtration. This effluent is discharged to the main plant pumping station, mixed with make-up water and reused.

Plant J - Figure VII-3

Sinter plant scrubber wastewaters are combined with the underflow from the blast furnace treatment system thickener and treated in a second thickener. Most of the overflow is recycled to the sinter plant gas scrubber system. A cooling tower in the recycle line reduces the recycled wastewater temperature. A portion of the overflow is discharged to a POTW.

Plant K

Sinter plant scrubber system wastewaters are combined with the underflow from six blast furnace thickeners and settled in another thickener. The thickener overflow is combined with the BOF treatment system overflow and treated by clarification. Clarifier overflows are then stored in settling ponds for recycle.

Plant 016 - Figure VII-4

Wastewaters from the sinter mixing drum and sinter machine scrubbers are combined in a moisture eliminator cone, which acts as a settling chamber. The supernate of the eliminator is recycled to the sinter machine scrubbers, while the underflow is discharged to a central treatment system for further treatment.

Plant 017 - Figure VII-5

Wastewaters from six sinter process scrubbers are mixed with blast furnace wastewaters and treated to remove suspended solids in a thickener. The thickener overflow is further treated with alkaline chlorination and sedimentation in a second thickener prior to discharge.

Plant 019 - Figure VII-6

Sinter plant wastewaters are treated by adding lime to aid precipitate formation. The floc is settled in a "Lamella" thickener. The overflow is mixed with make-up water and recycled to the steam hydro-scrubbers. The underflow is discharged to a blast furnace clarifier for further treatment.

TABLE VII-1

OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

Symbols

A. Operating Modes

1. OT Once-Through

2. Rt,s,n Recycle, where t = type waste
s = stream recycled
n = % recycled

t: U = Untreated
T = Treated

	s	n
P	Process Wastewater	% of raw waste flow
F	Flume Only	% of raw waste flow
S	Flume and Sprays	% of raw waste flow
FC	Final Cooler	% of FC flow
BC	Barometric Cond.	% of BC flow
VS	Abs. Vent Scrub.	% of VS flow
FH	Fume Hood Scrub.	% of FH flow

3. REt,n Reuse, where t = type
n = % of raw waste flow

t: U = before treatment
T = after treatment

4. BDn Blowdown, where n = discharge as % of raw waste flow

B. Control Technology

10. DI Deionization

11. SR Spray/Fog Rinse

12. CC Countercurrent Rinse

13. DR Drag-out Recovery

C. Disposal Methods

20. H Haul Off-Site

21. DW Deep Well Injection

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 2

C. Disposal Methods (cont.)

22.	Qt,d	Coke Quenching, where t = type d = discharge as % of makeup t: DW = Dirty Water CW = Clean Water
23.	EME	Evaporation, Multiple Effect
24.	ES	Evaporation on Slag
25.	EVC	Evaporation, Vapor Compression Distillation

D. Treatment Technology

30.	SC	Segregated Collection
31.	E	Equalization/Blending
32.	Scr	Screening
33.	OB	Oil Collecting Baffle
34.	SS	Surface Skimming (oil, etc.)
35.	PSP	Primary Scale Pit
36.	SSP	Secondary Scale Pit
37.	EB	Emulsion Breaking
38.	A	Acidification
39.	AO	Air Oxidation
40.	GF	Gas Flotation
41.	M	Mixing
42.	Nt	Neutralization, where t = type t: L = Lime C = Caustic A = Acid W = Wastes O = Other, footnote

D. Treatment Technology (cont.)

43. FLt Flocculation, where t = type

t: L = Lime
A = Alum
P = Polymer
M = Magnetic
O = Other, footnote

44. CY Cyclone/Centrifuge/Classifier

44a. DT Drag Tank

45. CL Clarifier

46. T Thickener

47. TP Tube/Plate Settler

48. SLn Settling Lagoon, where n = days of retention time

49. BL Bottom Liner

50. VF Vacuum Filtration (of e.g., CL, T, or TP underflows)

51. Ft,m,h Filtration, where t = type
m = media
h = head

t	m	h
D = Deep Bed	S = Sand	G = Gravity
F = Flat Bed	O = Other, footnote	P = Pressure

52. CLt Chlorination, where t = type

t: A = Alkaline
B = Breakpoint

53. CO Chemical Oxidation (other than CLA or CLB)

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 4

D. Treatment Technology (cont.)

54.	BOt	Biological Oxidation, where t = type t: An = Activated Sludge n = No. of Stages T = Trickling Filter B = Biodisc O = Other, footnote
55.	CR	Chemical Reduction (e.g., chromium)
56.	DP	Dephenolizer
57.	ASt	Ammonia Stripping, where t = type t: F = Free L = Lime C = Caustic
58.	APt	Ammonia Product, where t = type t: S = Sulfate N = Nitric Acid A = Anhydrous P = Phosphate H = Hydroxide O = Other, footnote
59.	DSt	Desulfurization, where t = type t: Q = Qualifying N = Nonqualifying
60.	CT	Cooling Tower
61.	AR	Acid Regeneration
62.	AU	Acid Recovery and Reuse
63.	ACt	Activated Carbon, where t = type t: P = Powdered G = Granular
64.	IX	Ion Exchange
65.	RO	Reverse Osmosis
66.	D	Distillation

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 5

D. Treatment Technology (cont.)

67.	AAl	Activated Alumina
68.	OZ	Ozonation
69.	UV	Ultraviolet Radiation
70.	CNTt,n	Central Treatment, where t = type n = process flow as % of total flow t: 1 = Same Subcats. 2 = Similar Subcats. 3 = Synergistic Subcats. 4 = Cooling Water 5 = Incompatible Subcats.
71.	On	Other, where n = Footnote number
72.	SB	Settling Basin
73.	AE	Aeration
74.	PS	Precipitation with Sulfide

TABLE VII-2

SUMMARY OF DATA FOR SINTERING OPERATIONS DISCHARGING TO CENTRAL TREATMENT FACILITIES

Plant Code	Applied Flow (gal/ton)	Discharge Flow (gal/ton)	Discharge Percent of Total Flow	Contributing Wastewater Sources
0060	1667	219	46	Blast Furnace
0060B	2186	2186	5	Blast Furnace, etc.
0112A	1604	288	83	Miscellaneous
0112B	133	133	28	Blast Furnace and BOF Sludges
0112C	1292	793	39	Blast Furnace
0112D	1432	142	2	General Plant Sources
0396A	341	85	76	Blast Furnace Sludges
0432A	245	245	6	Blast Furnace
0492A	2582	2582	11	General Plant Sources
0584C	1368	1368	1	BOF, Finishing
0584F	106	106	Unk	Blast Furnace
0856Q	2805	117	1	Blast Furnace
0920B	134	134	3	Blast Furnace
0946A	6605	6605	5	Blast Furnace
0948C	1124	138	-	Blowdown to Blast Furnace Gas Scrubber System

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Unk: Unknown

TABLE VII-3

RAW WASTEWATERS - SINTERING
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES AND TOXIC POLLUTANT SURVEYS

PLANT CODES	0432A		0396A		0112D		0432A		0060F(1)		AVERAGES	
Sample Point(s)	H 6		J 1 - Sludge		016 B+C		017 D+E		019 B			
Flow, gal/ton	104		341		1432		245		301			
	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs
Oil and Grease	504	0.219	461	0.551	114	0.678	9.1	0.00927	210	0.263	245	0.344
Suspended Solids	4345	1.89	18,629	27.6	558	3.33	5378	5.49	809	1.01	6110	7.86
pH	9.6		12.7		7.1 - 12.3		11.3 - 12.0		5.9		5.9 - 12.7	
Fluoride	0.64	0.000278	2.5	0.00368	27	0.162	6.4	0.00656	47	0.0589	16.7	0.0463
Phenolic Compounds	0.439	0.000191			1.86	0.0111	0.164	0.000167	2.20	0.00276	1.17	0.00355
39 Fluoranthene					0.254	0.00152	0.003	0.000003	ND	ND	0.086	0.000508
65 Phenol					0.056	0.000331	0.039	0.000040	1.037	0.00130	0.377	0.000557
76 Chrysene					0.316	0.00189	0.006	0.000007	ND	ND	0.107	0.000632
84 Pyrene					0.321	0.00191	0.006	0.000007	0.007	0.000009	0.111	0.000642
118 Cadmium					0.048	0.000288	#	#	1.333	0.00167	0.69	0.000979
119 Chromium					0.098	0.000584	0.619	0.000632	0.020	0.000025	0.25	0.000414
120 Copper					0.521	0.00311	0.065	0.000067	0.600	0.000751	0.40	0.00131
121 Cyanides	15.2	0.00660			0.010	0.000060	0.145	0.000148	0.263	0.000329	3.9	0.00178
122 Lead					5.88	0.0351	ISD	ISD	5.33	0.00668	5.6	0.0209
124 Nickel					0.010	0.000060	#	#	0.200	0.000250	0.10	0.000155
126 Silver					0.010	0.000061	#	#	0.013	0.000016	0.01	0.000038
128 Zinc					0.545	0.00325	0.939	0.000958	8.67	0.0109	3.38	0.00504

---

(1) : The metals analytical data for this plant represents dissolved values.
ISD : Insufficient data to complete evaluation
ND : Not Determined
# : Determinations for parameter are qualified

TABLE VII-4

EFFLUENTS - SINTERING
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES AND TOXIC POLLUTANT SURVEYS

Plant Codes	0432A H	0396A J		0112D(1) 016		0432A 017		0060F(2) 019	
Sample Point(s)	-	2		D		D+E/(B+C+D+E) F		D	
Flow, gal/ton	104	80		142		245		26.4	
C&TT		Polymer, clarifier, cooling tower, vacuum filter		Lime Neut.,polymer clarifier,thickener lagoon,skimming vac. filter		Alk.Chlorination, polymer,screening, thickener, thickener vac. filter		Lime Neut.,polymer, "Lamella"	
		mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs
Oil and Grease	Not Available*	1.0	0.00027	181	0.107	5	ISD	1120	0.123
Suspended Solids		9.2	0.0032	827	0.488	38	0.112	14651	1.61
pH		12.8	-	7.2	-	10.6	-	8.6	-
Fluoride		8.5	0.0029	32	0.0189	3.2	0.00315	182	0.0200
Phenolic Compounds				1.33	0.000784	2.86	0.000169	2.07	0.000227
39 Fluoranthene				0.310	0.000183	0.007	0.000000	0.862	0.000095
65 Phenol				0.075	0.000044	0.630	0.000042	0.987	0.000108
76 Chrysene				0.410	0.000242	0.007	0.000006	0.053	0.000006
84 Pyrene				0.295	0.000175	0.007	0.000001	1.122	0.000123
118 Cadmium				0.065	0.000038	#	ISD	0.767	0.000084
119 Chromium				0.090	0.000053	#	ISD	0.010	0.000001
120 Copper				0.550	0.000324	0.026	ISD	0.267	0.000029
121 Cyanides				0.010	0.000006	1.11	0.000014	0.163	0.000018
122 Lead				5.50	0.00325	0.079	ISD	0.800	0.000088
124 Nickel				0.015	0.000009	#	#	0.133	0.000015
126 Silver				0.009	0.000005	#	#	0.010	0.000001
128 Zinc				0.550	0.000324	0.935	0.000048	5.000	0.000549

---

(1) The effluent from this system was the bottom flow from a moisture eliminator.

(2) The metals analytical data for this plant represent dissolved values. The discharge from this system was the underflow from a "Lamella" thickener.

: Determinations for parameter are qualified.
* : These values could not be adequately evaluated.

ISD: Insufficient data to complete evaluation.
ND : Not Determined

TABLE VII-5

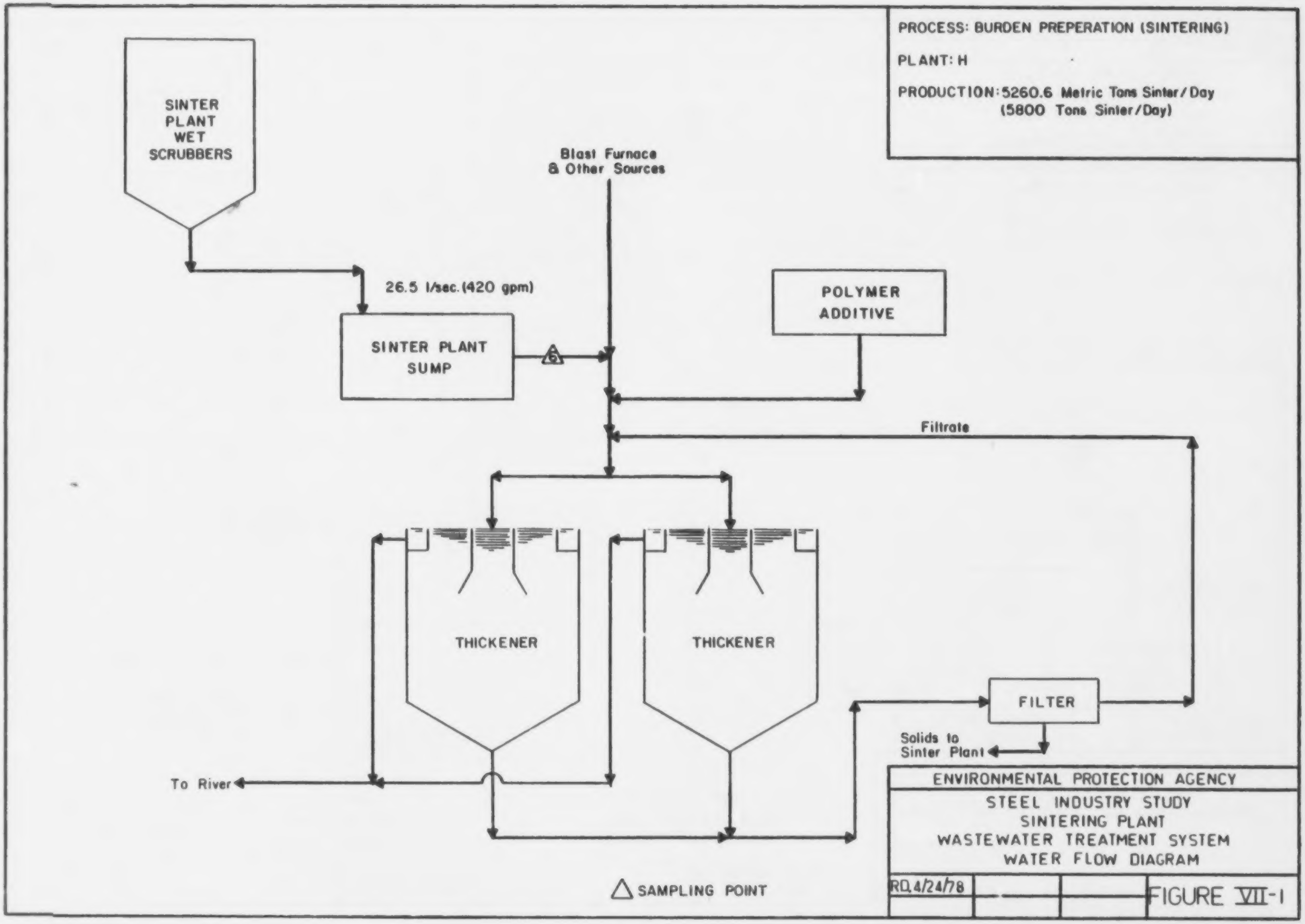
SUMMARY OF LONG-TERM EFFLUENT ANALYTICAL DATA SINTERING

(All concentrations expressed in mg/l)

Plant Code C&TT	0112A Neutralization with lime, clarifier, vacuum filter				0920F Neutralization with caustic, clarifier			
	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation
Oil and Grease	*	-	-	-	60	14	70	10.04
Suspended Solids	180	38.4	158	25.35	60	36.1	149	26.75
pH	-	-	-	-	60	8.1	9.3	-
Flow, gal/min	180	1,542	2,591	539.99	59	24	49	12.8
Temperature, °C	-	-	-	-	60	31	45	8.3
Fluoride	-	-	-	-	11	41.2	70	16.8
Ammonia	180	34.9	60	6.94	-	-	-	-
Cyanide	180	0.097	0.444	0.083	-	-	-	-
Phenols	180	0.06	1.24	0.12	-	-	-	-
Total Solids	-	-	-	-	19	26,236	45,176	8,902

---

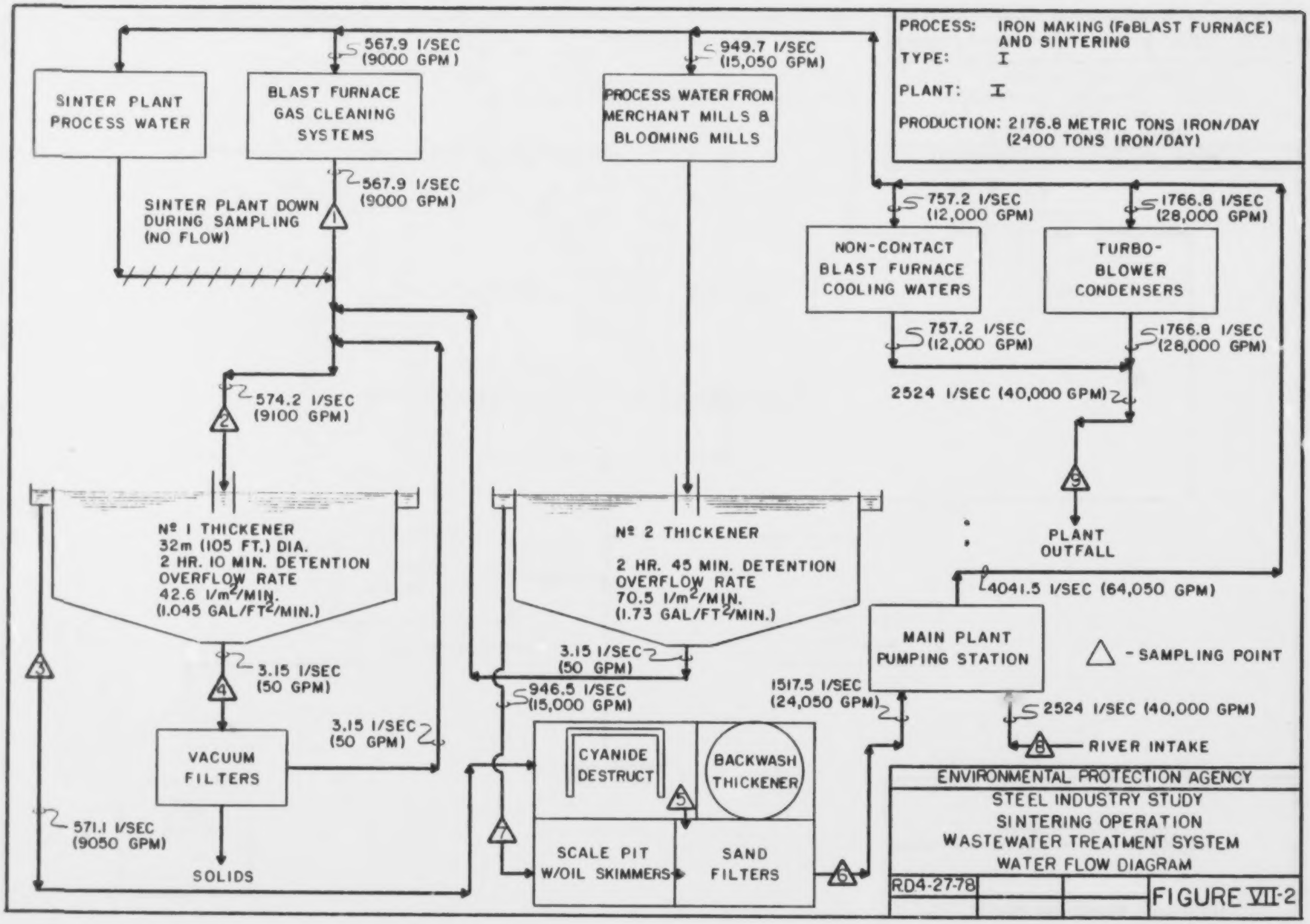
*: No Data

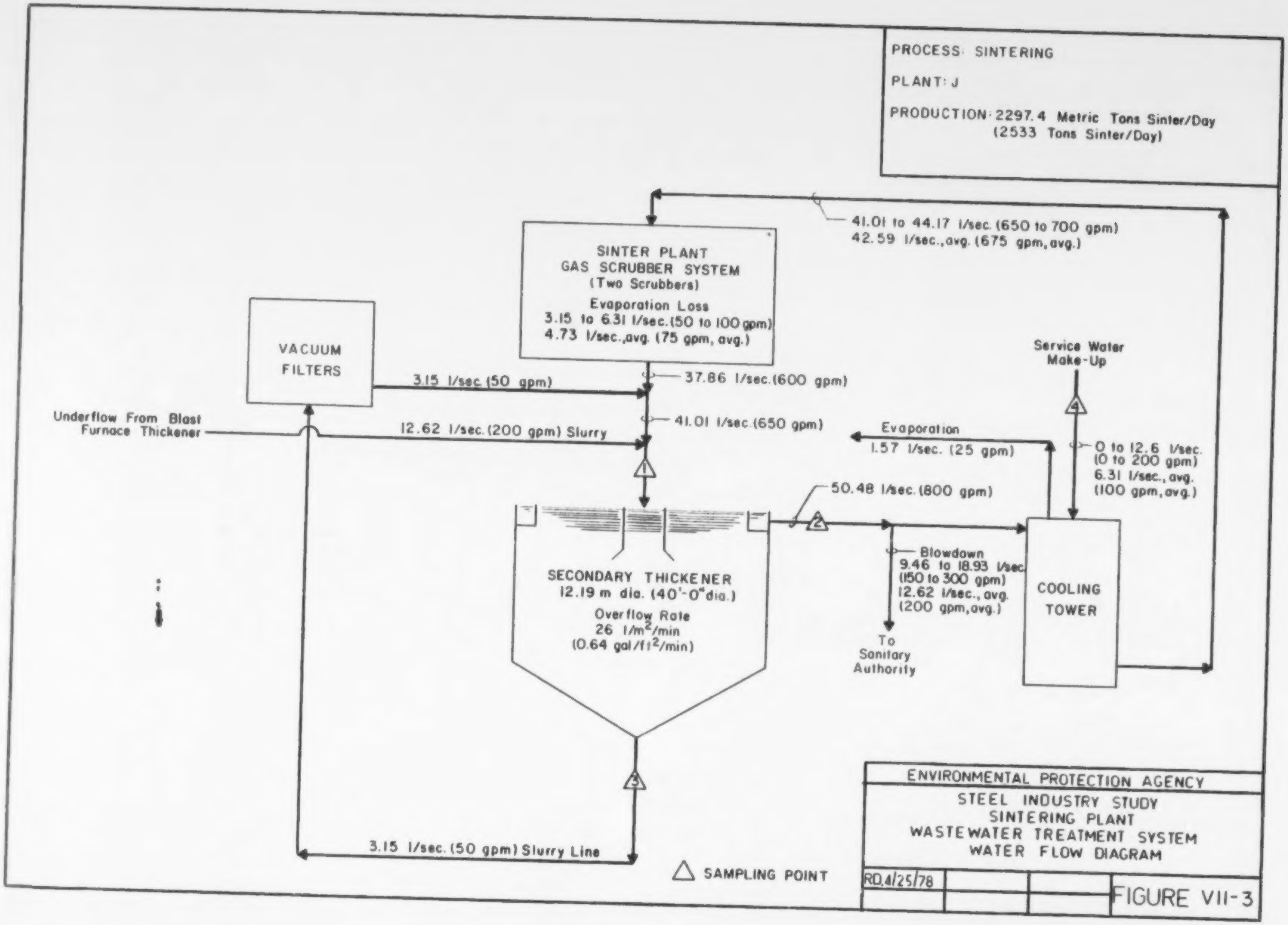

PROCESS: BURDEN PREPERATION (SINTERING)
PLANT: H
PRODUCTION: 5260.6 Metric Tons Sinter/Day
(5800 Tons Sinter/Day)
SINTER PLANT WET SCRUBBERS
26.5 l/sec. (420 gpm)
SINTER PLANT SUMP
6
Blast Furnace & Other Sources
POLYMER ADDITIVE
Filtrate
THICKENER
THICKENER
FILTER
Solids to Sinter Plant
To River
△ SAMPLING POINT
RD 4/24/78

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-1


PROCESS: IRON MAKING (FeBLAST FURNACE) AND SINTERING
TYPE: I
PLANT: I
PRODUCTION: 2176.8 METRIC TONS IRON/DAY (2400 TONS IRON/DAY)
SINTER PLANT PROCESS WATER
BLAST FURNACE GAS CLEANING SYSTEMS
567.9 l/SEC (9000 GPM)
567.9 l/SEC (9000 GPM)
949.7 l/SEC (15,050 GPM)
PROCESS WATER FROM MERCHANT MILLS & BLOOMING MILLS
SINTER PLANT DOWN DURING SAMPLING (NO FLOW)
1
757.2 l/SEC (12,000 GPM)
1766.8 l/SEC (28,000 GPM)
NON-CONTACT BLAST FURNACE COOLING WATERS
TURBO-BLOWER CONDENSERS
757.2 l/SEC (12,000 GPM)
1766.8 l/SEC (28,000 GPM)
2524 l/SEC (40,000 GPM)
574.2 l/SEC (9100 GPM)
2
9
PLANT OUTFALL
Nº 1 THICKENER
32m (105 FT.) DIA.
2 HR. 10 MIN. DETENTION
OVERFLOW RATE
42.6 l/m²/MIN.
(1.045 GAL/FT²/MIN.)
Nº 2 THICKENER
2 HR. 45 MIN. DETENTION
OVERFLOW RATE
70.5 l/m²/MIN.
(1.73 GAL/FT²/MIN.)
4041.5 l/SEC (64,050 GPM)
MAIN PLANT PUMPING STATION
- SAMPLING POINT
3
3.15 l/SEC (50 GPM)
4
3.15 l/SEC (50 GPM)
946.5 l/SEC (15,000 GPM)
1517.5 l/SEC (24,050 GPM)
2524 l/SEC (40,000 GPM)
8
RIVER INTAKE
VACUUM FILTERS
3.15 l/SEC (50 GPM)
CYANIDE DESTRUCT
5
BACKWASH THICKENER
571.1 l/SEC (9050 GPM)
7
SCALE PIT W/OIL SKIMMERS
SAND FILTERS
6
SOLIDS
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING OPERATION
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD4-27-78
FIGURE VII-2


PROCESS: SINTERING
PLANT: J
PRODUCTION: 2297.4 Metric Tons Sinter/Day
(2533 Tons Sinter/Day)
SINTER PLANT
GAS SCRUBBER SYSTEM
(Two Scrubbers)
Evaporation Loss
3.15 to 6.31 l/sec. (50 to 100 gpm)
4.73 l/sec., avg. (75 gpm, avg.)
41.01 to 44.17 l/sec. (650 to 700 gpm)
42.59 l/sec., avg. (675 gpm, avg.)
VACUUM
FILTERS
3.15 l/sec. (50 gpm)
37.86 l/sec. (600 gpm)
Underflow From Blast
Furnace Thickener
12.62 l/sec. (200 gpm) Slurry
41.01 l/sec. (650 gpm)
1
SECONDARY THICKENER
12.19 m dia. (40'-0" dia.)
Overflow Rate
26 l/m²/min
(0.64 gal/ft²/min)
2
50.48 l/sec. (800 gpm)
Evaporation
1.57 l/sec. (25 gpm)
Service Water
Make-Up
4
0 to 12.6 l/sec.
(0 to 200 gpm)
6.31 l/sec., avg.
(100 gpm, avg.)
Blowdown
9.46 to 18.93 l/sec.
(150 to 300 gpm)
12.62 l/sec., avg.
(200 gpm, avg.)
To
Sanitary
Authority
COOLING
TOWER
3
3.15 l/sec. (50 gpm) Slurry Line
△ SAMPLING POINT
RD.4/25/78

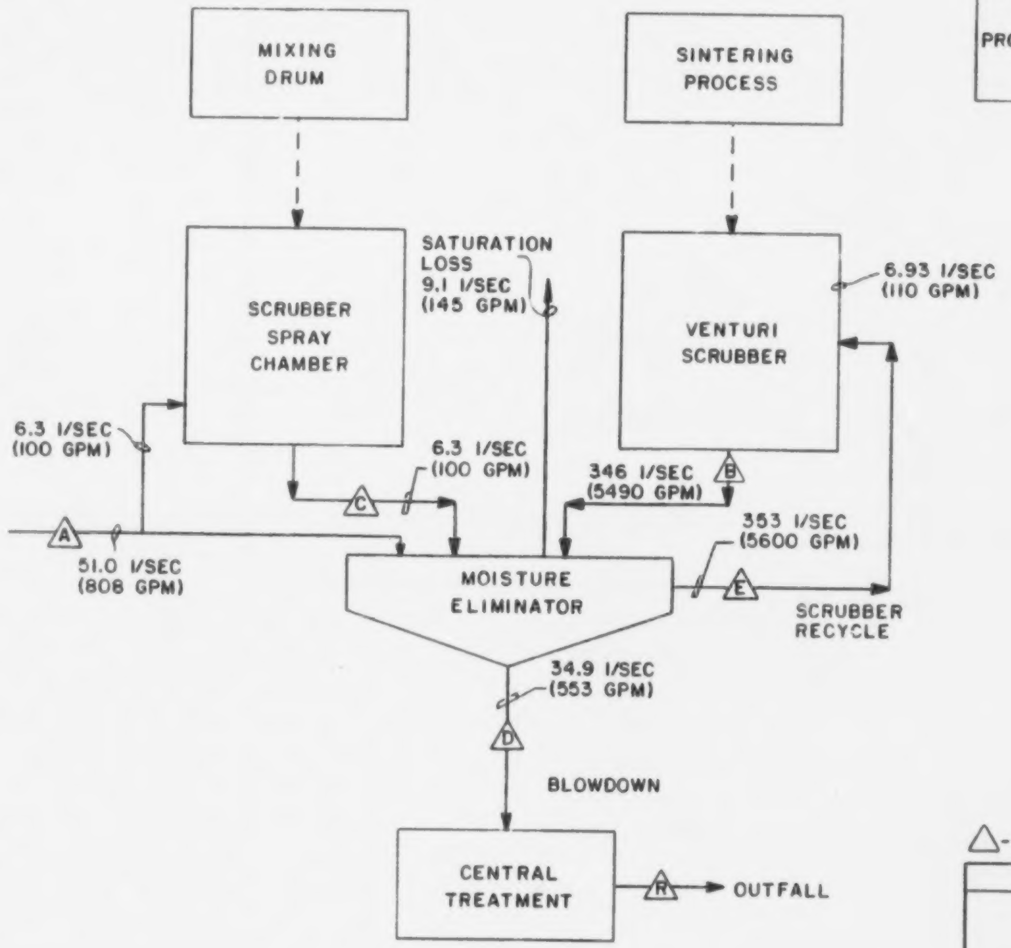
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-3

PROCESS: SINTERING PLANT

PLANT: 016

PRODUCTION: 5100 METRIC TONS STEEL/DAY (5622 TONS STEEL/DAY)

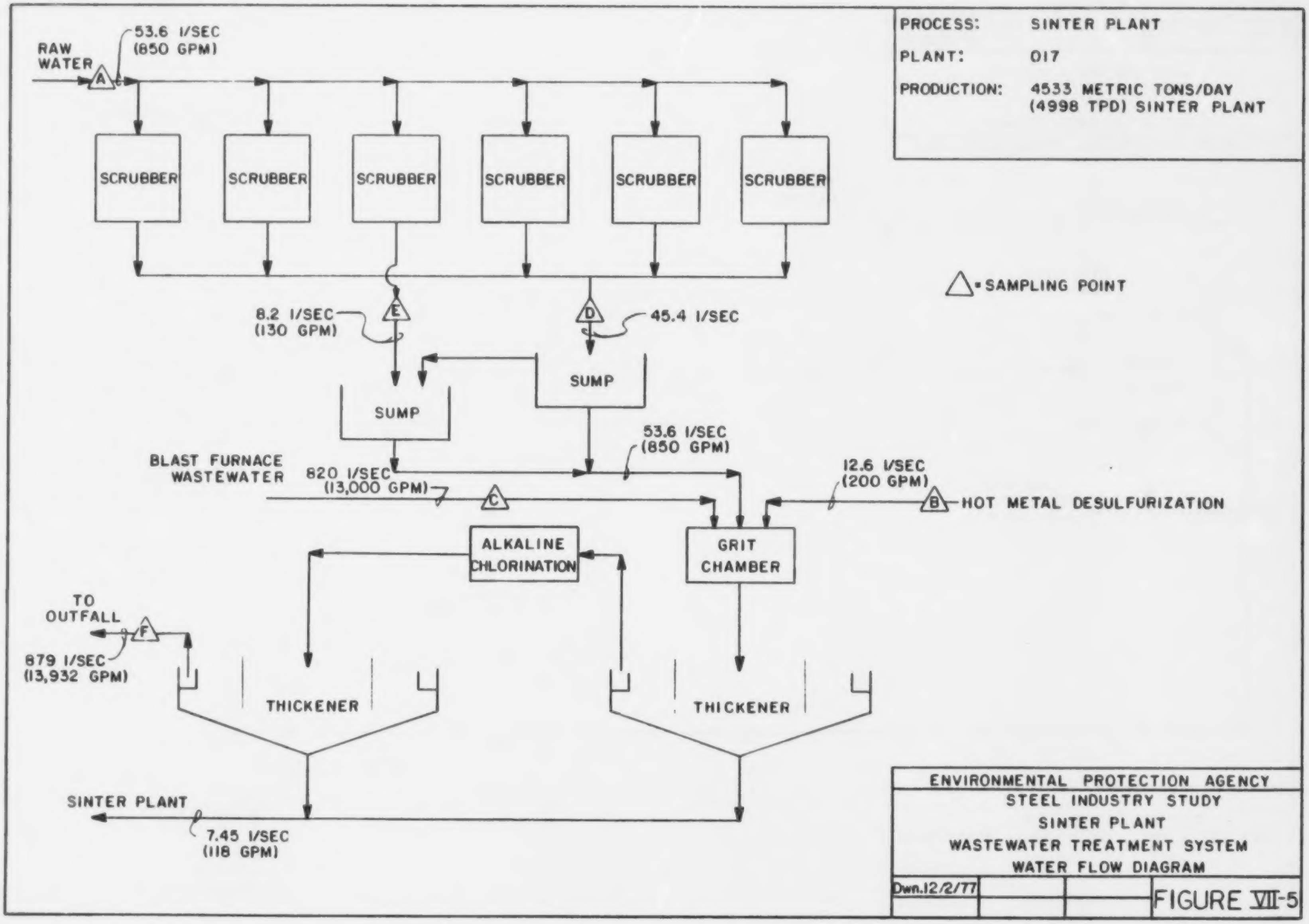

MIXING DRUM
SINTERING PROCESS
SCRUBBER SPRAY CHAMBER
SATURATION LOSS 9.1 l/SEC (145 GPM)
VENTURI SCRUBBER
6.93 l/SEC (110 GPM)
6.3 l/SEC (100 GPM)
6.3 l/SEC (100 GPM)
346 l/SEC (5490 GPM)
B
C
A
353 l/SEC (5600 GPM)
51.0 l/SEC (808 GPM)
MOISTURE ELIMINATOR
E
SCRUBBER RECYCLE
34.9 l/SEC (553 GPM)
D
BLOWDOWN
CENTRAL TREATMENT
R
OUTFALL

△- SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY

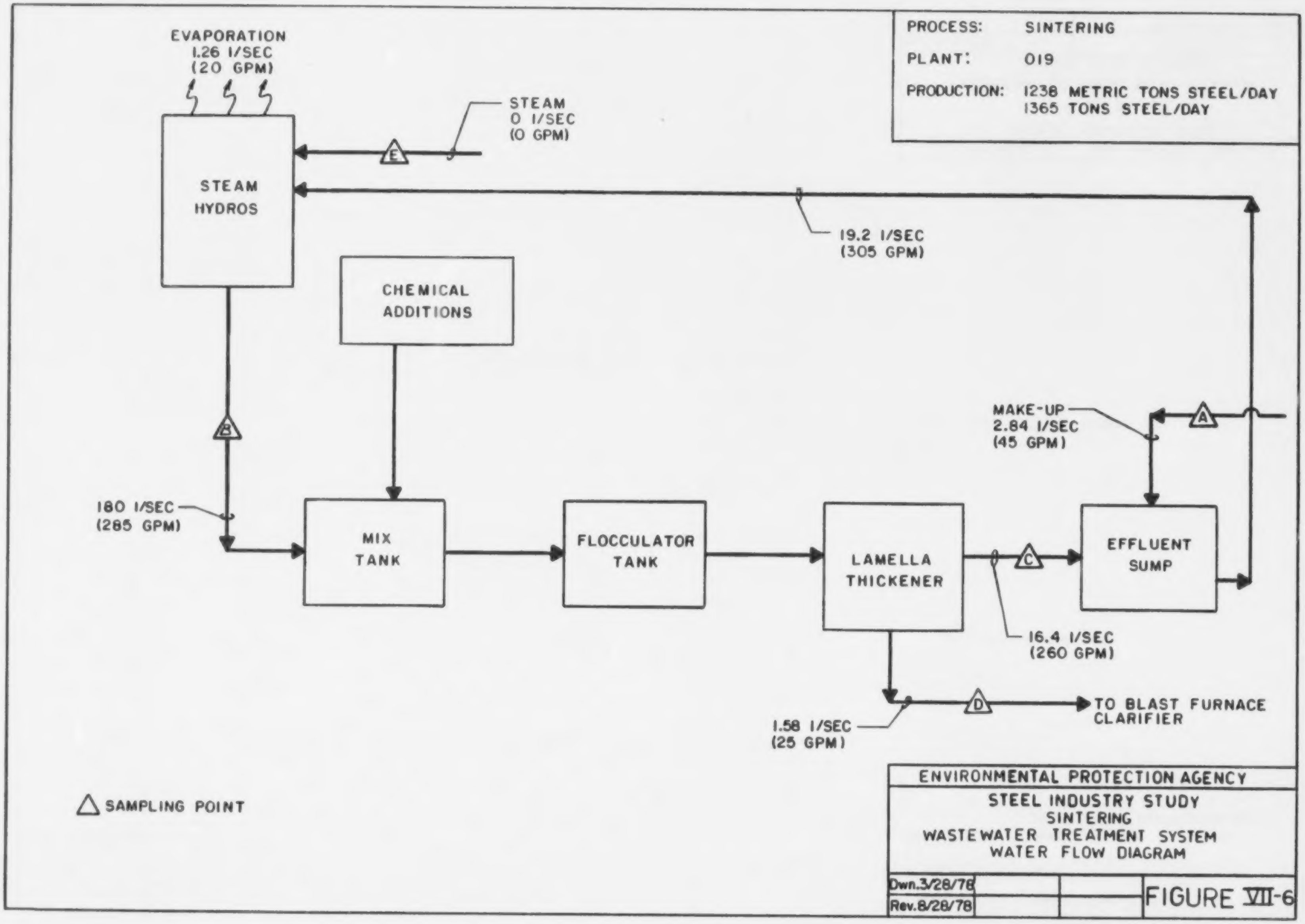
STEEL INDUSTRY STUDY
SINTERING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-4


PROCESS: SINTER PLANT
PLANT: 017
PRODUCTION: 4533 METRIC TONS/DAY (4998 TPD) SINTER PLANT
△ = SAMPLING POINT
RAW WATER
A
53.6 l/SEC (850 GPM)
SCRUBBER
SCRUBBER
SCRUBBER
SCRUBBER
SCRUBBER
SCRUBBER
E
8.2 l/SEC (130 GPM)
D
45.4 l/SEC
SUMP
SUMP
53.6 l/SEC (850 GPM)
BLAST FURNACE WASTEWATER
820 l/SEC (13,000 GPM)
C
12.6 l/SEC (200 GPM)
B
HOT METAL DESULFURIZATION
ALKALINE CHLORINATION
GRIT CHAMBER
TO OUTFALL
F
879 l/SEC (13,932 GPM)
THICKENER
THICKENER
SINTER PLANT
7.45 l/SEC (118 GPM)
Dwn.12/2/77

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTER PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-5


EVAPORATION
1.26 l/SEC
(20 GPM)
STEAM
0 l/SEC
(0 GPM)
E
STEAM
HYDROS
19.2 l/SEC
(305 GPM)
CHEMICAL
ADDITIONS
B
180 l/SEC
(285 GPM)
MIX
TANK
FLOCCULATOR
TANK
LAMELLA
THICKENER
C
16.4 l/SEC
(260 GPM)
MAKE-UP
2.84 l/SEC
(45 GPM)
A
EFFLUENT
SUMP
D
1.58 l/SEC
(25 GPM)
TO BLAST FURNACE
CLARIFIER
△ SAMPLING POINT
Dwn.3/28/78
Rev.8/28/78

PROCESS: SINTERING

PLANT: 019

PRODUCTION: 1238 METRIC TONS STEEL/DAY
1365 TONS STEEL/DAY

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-6

SINTERING SUBCATEGORY

SECTION VIII

COST, ENERGY, AND NONWATER QUALITY IMPACTS

Introduction

This section presents the incremental costs incurred in applying the various treatment systems described in Sections IX to XIII. These costs are estimated from model treatment systems. The cost analysis includes, in addition to the cost associated with the application of the various technologies, a consideration of energy requirements and nonwater quality impacts. In addition, sludge and waste oil generation rates, the BCT cost comparison and the consumptive use of water are reviewed.

Actual Costs Incurred by the Plants Sampled or Solicited for This Study

Water pollution control costs supplied by the industry for sintering operations surveyed during this study or included in D-DCP responses are presented in Table VIII-1. These costs have been updated to July 1978 dollars from the actual cost (current year) data supplied by the industry.

The Agency compared the capital cost data reported for several plants to its capital cost estimates. This comparison was made to determine whether the Agency's estimated treatment model costs are sufficiently generous to cover the industry's actual costs, including site-specific and other incidental costs. Following is a tabulation of the actual capital costs reported by the industry (refer to Table VIII-1) and EPA estimated costs developed from the model cost:

Plant No.	Actual Cost ($)	Estimated Cost ($)
0060	733,550	1,870,000
0856F	511,020	2,249,000
0864A	1,731,048	1,306,000
0920F	2,626,200	1,203,000
0396A	832,000	1,045,000
TOTAL	$6,433,818	$7,673,000
0112A	$1,206,430	$6,892,000

The large difference between the actual and estimated costs for plant 0112A is due to substantial differences in production capacity and flow between this plant and the treatment model. On this basis, the costs for Plant 0112A were not included in the totals. While actual costs were also reported for Plant 0432A, which has a central treatment system for blast furnace and sintering wastewaters, a reliable determination of the sintering wastewater treatment costs could not be made because the sinter plant flow is small in relation to the total central treatment system flow.

Referring to the costs for the remaining five plants, actual costs for two of the plants are greater than the estimated costs and three of the estimated costs are higher. The most noteworthy observation, however, is the comparison of the total costs, as this more closely reflects on the applicability of the cost of compliance to the industry. As the reported costs are about 16% less than the Agency's estimated costs, the estimated costs compare favorably in two ways. First, the Agency's total cost estimate is sufficiently generous to account for the various site-specific and other incidental costs associated with industry's compliance with the proposed limitations. Second, the Agency's total cost estimate is not excessively generous and thus provides a fair indication of the cost of treatment to the industry.

Control and Treatment Technologies (C&TT) Recommended for Use in the Sintering Subcategory

The components of the BPT and BAT model treatment systems are presented in Table VIII-2. It should be noted that the proposed regulation does not require the installation of the model treatment system, as any treatment arrangement which achieves the proposed effluent limitations is adequate. Table VIII-2 presents information pertaining to the following items.

1. Status and reliability
2. Problems and limitations
3. Implementation time
4. Land requirements
5. Environmental impacts other than water
6. Solid waste generation

Cost, Energy, and Nonwater Quality Impacts

Introduction

Compliance with the proposed BPT, BCT, BAT limitations and NSPS, PSES, and PSNS will require additional expenditures (both investment and operating) and additional energy consumption. This section addresses these requirements and the air pollution, water consumption and solid waste disposal impacts associated with each treatment system considered. Costs and energy requirements were estimated on the basis of treatment models developed in Sections IX through XIII of this report.

Estimated Costs for the Installation of Pollution Control Technologies

A. Costs Required to Achieve the Proposed BPT Limitations

As a first step to estimate the costs of each treatment model, the Agency developed a model system upon which cost estimates were to be based. The model size (tons/day) was developed on the basis of the average production capacity for all "wet" sintering operations. The treatment model applied flow is also an average. The components and effluent flow discussed in Section IX were then incorporated to complete the development of the treatment model. Table VIII-3 presents the estimated and annual expenditures associated with the application of the model BPT treatment technologies. The Agency then developed unit costs for each treatment system component.

The capital requirements for achieving the proposed BPT limitations were determined by applying the model treatment component costs, adjusted for size, to each "wet" sintering operation. Table VIII-4 presents a summary of the estimated expenditures already made or required to achieve the BPT level of treatment. Based upon these data, the Agency estimates that about 27.9 million dollars remained to be spent for BPT facilities as of January 1, 1978. The estimated total annual cost of operation of BPT for sintering operations is about 37.3 million dollars.

B. Costs Required to Achieve the Proposed BAT Limitations

The Agency considered four treatment alternatives as model BAT treatment systems. Reference is made to Section X for information on each system. The additional investment and annual expenditures involved in applying each of the BAT alternative treatment systems to the model plant are presented in Table VIII-5. The BAT costs for the subcategory were determined by multiplying unit costs by the number of "wet" sintering operations requiring each component. Subcategory annual costs for BAT were obtained by multiplying the model annual costs by the number of "wet" sintering operations. Following are the estimated investment and annual costs for each BAT alternative:

BAT Alternative	Investment Costs In-Place	Investment Costs Required	Annual Costs
No.1	$ 760,000	$ 4,350,000	$ 940,000
No.2	$1,870,000	$10,000,000	$ 2,270,000
No.3	$2,000,000	$11,250,000	$ 2,600,000
No.4	$2,000,000	$51,240,000	$19,740,000

C. Costs Required to Achieve the Proposed BCT Limitations

Since the BCT model treatment systems are compatible with and part of the model BAT alternatives, BCT costs are included in the BAT costs noted above. However, the proposed BCT limitations pertain only to conventional pollutants. The BCT cost analysis is presented in Table VIII-6, while additional information regarding BCT is provided in Section XI.

D. Costs Required to Achieve the Proposed NSPS

The Agency considered four treatment alternatives as model NSPS treatment systems. The NSPS treatment systems are similar to the BPT/BAT treatment systems, however, the model size has been changed to account for the trend toward larger operations. The NSPS model treatment system size is based upon the average production capacity of those facilities which began operation in the last decade. The NSPS alternative treatment system costs are presented in Table VIII-7.

E. Costs Required to Achieve the Proposed Pretreatment Standards

Pretreatment standards apply to those existing and new sources which discharge wastewaters to POTWs. The alternative pretreatment systems are similar to those for BPT and those for the respective model BAT treatment systems. The model size for pretreatment standards for existing sources (PSES) is the same as that of the BPT and BAT treatment models, while the model size for pretreatment standards for new sources (PSNS) is the same as that of the NSPS treatment model. This system provides considerable reductions in effluent flows and effluent levels and loads, in particular for the toxic pollutants. Section XIII contains additional information pertaining to the pretreatment standards. The costs for the PSES models are presented in Table VIII-8. The PSNS model costs are identical to the model costs of NSPS Alternative Nos. 1-3 which are presented in Table VIII-7.

Energy Impacts

Moderate amounts of energy will be required for the BPT model and BAT, NSPS, PSES, and PSNS alternative treatment systems for the sintering subcategory. The major energy expenditures occur at BPT, while the BAT model treatment system requires relatively minor additional energy expenditures. This relationship reflects the high recycle rate in the BPT model treatment system. Energy requirements for PSES will approximate the corresponding BPT and BAT systems, while the requirements for NSPS and PSNS will be slightly greater than those for the corresponding BPT and BAT system.

A. Energy Impacts at BPT

The Agency estimated the energy requirements for this subcategory based upon the assumption that all "wet" sintering operations will install treatment systems similar to that of the appropriate model treatment system with flows similar to that of the model. On this basis, the energy requirements for BPT for all "wet" sintering operations is 71.8 million kilowatt hours of electricity per year. This estimate represents about 0.13% of the 57 billion kilowatt hours of electricity used by the steel industry in 1978.

B. Energy Impacts at BAT

The estimated energy requirements for the BAT alternative treatment systems are based upon the same assumptions noted above for BPT. The estimated energy requirements for the four alternative systems, and the relationship to 1978 industry power consumption, are as follows:

BAT Alternative	kwh per Year	% of Industry Usage
No.1	1.18 million	0.002%
No.2	3.36 million	0.006%
No.3	3.70 million	0.006%
No.4	10.58 million	0.019%

The Agency considers these requirements to be justified in light of the total industry usage and the pollution reduction benefits obtained.

C. Energy Impacts at NSPS and Pretreatment

The estimated energy requirements for the NSPS, PSNS, and PSES alternative treatment systems are as follows:

Model	kwh/Year
NSPS-1	6.97 million
NSPS-2	7.13 million
NSPS-3	7.16 million
NSPS-4	7.64 million
PSNS-1	6.97 million
PSNS-2	7.13 million
PSNS-3	7.16 million
PSES-1	3.46 million
PSES-2	3.57 million
PSES-3	3.58 million

The estimated energy requirements for the NSPS and PSNS alternative treatment systems are greater than the corresponding BPT and BAT alternative totals because of model size differences. Estimates of the total energy impacts for NSPS and PSNS are not included since projections of capacity additions were not made as part of this study. PSES energy impacts are included in those for BPT and BAT.

Nonwater Quality Impacts

In general, the Agency concluded that nonwater quality impacts associated with the proposed treatment technologies will be minimal. Following are discussions of the impacts which were evaluated.

A. Air Pollution

Sulfide addition is included in BAT Alternative 2. In the event of treatment process control upsets, an atmospheric discharge of sulfides could occur. However, as this sulfide addition is used in conjunction with lime addition, the possibility of atmospheric sulfide discharges, which are aggravated at an acidic pH, would be greatly reduced.

The use of alkaline chlorination in conjunction with BAT Alternatives Nos. 3 and 4, may result in the localized atmospheric discharge of chlorine or chlorine compounds. However, proper venting and operating practices and procedures would greatly reduce or eliminate any air pollution problems associated with alkaline chlorination. In addition to the above atmospheric discharges, regeneration of spent activated carbon from BAT Alternative No. 4 may also result in the atmospheric discharge of various pollutants. However, the regeneration temperatures are sufficiently high to oxidize most organic pollutants.

In view of these observations, the Agency does not consider the impacts of air pollution to be significant.

B. Solid Waste Disposal

The BPT model and BAT alternative treatment systems will generate significant quantities of solids and oils and greases which require disposal. A summary of the solid waste generation for all "wet" sintering operations at the BPT and BAT levels of treatment follows:

Treatment Level	Solid Waste Generation Sintering Subcategory (Tons/Year)
BPT	1,173,000
BAT Alternative No.1	384
BAT Alternative No.2	1,550
BAT Alternative No.3	1,530
BAT Alternative No.4	1,530

As shown above, significant amounts of solid wastes are generated by the BPT model treatment system, while the BAT alternative treatment systems generate relatively minor additional amounts. Most of the solid wastes generated require proper disposal. The oils which cannot be reused or reclaimed would also require proper disposal, generally off-site.

The estimated amounts of solid wastes generated by the NSPS and Pretreatment alternative treatment systems follow:

Treatment Level	Solid Waste Generation Treatment Model (Tons/Year)
NSPS Alternative No.1	97,800
NSPS Alternative No.2	97,900
NSPS Alternative No.3	97,900
NSPS Alternative No.4	97,900
PSNS Alternative No.1	97,800
PSNS Alternative No.2	97,900
PSNS Alternative No.3	97,900
PSES Alternative No.1	55,900
PSES Alternative No.2	55,900
PSES Alternative No.3	55,900

As noted previously in this section, the NSPS and PSNS alternative treatment systems are the same as the BPT and BAT treatment systems, except for model size. The solid wastes generated at the NSPS and Pretreatment levels are of the same nature and present the same disposal requirements as those presented for BPT and BAT.

C. Water Consumption

Evaporative cooling is not included as a treatment step in this subcategory, and those treatment steps which are included are essentially not water consumptive. As a result, there are no impacts due to water consumption at the BPT and BAT levels of treatment.

Summary of Impacts

In summary, the Agency concludes that the pollutant load reduction benefits described below for the sintering subcategory outweigh any adverse energy and non-water quality environmental impacts:

	Effluent Discharges (Tons/Year)		
	Raw Waste	Proposed BPT	Proposed BAT & BCT
Flow, MGD	122.6	8.4	6.3
TSS	1,138,650	639	144
Oil and Grease	45,730	128	47.9
Toxic Metals	616	24.3	6.7
Toxic Organics*	5.6	1.5	1.2
Fluoride	1,120	384	95.9
Cyanide, Total	37.3	6.4	2.4
Phenolic Compounds	37.3	25.6	1.0

* Toxic organics do not include phenolic compounds.

TABLE VIII-1

EFFLUENT TREATMENT COSTS
SINTERING

(All costs are expressed in July, 1978 Dollars)

Plant Code Reference No.	H 0432A	I 0946A	J 0396A	K 0112B	016 0432A	017 0060F	019 0060F	0060	0112A	0856F	0864A	0920F
Initial Investment Cost	NA	NA	832,000	NA	(4)	560,050(5)	NA	733,550	1,206,430	511,020	1,731,040	2,626,200
Annual Costs	NA	NA		NA								
Cost of Capital			35,776(1)			24,082(1)		31,543(1)	91,568(7)	21,974(1)	74,435(1)	112,926(1)
Depreciation			83,200(2)			56,050(2)		73,355(2)	67,024(7)	51,102(2)	173,105(2)	262,620(2)
Operation & Maintenance						24,643(6)					254,169	
Energy, Power, Chemicals, etc.			29,120(3)			3,044(6)		25,674(3)	42,225(8)	17,886(3)	102,626	91,917(3)
TOTAL	NA	NA	148,096	NA		107,719		130,572	200,817	90,962	604,335	467,463
$/Ton (9)	NA	NA	0.160	NA		0.061		0.219	0.068	0.041	0.745	1.323

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(1) Cost of capital is based on the formula, Initial Investment x 0.043.
(2) Depreciation is based on the formula, Initial Investment x 0.10.
(3) Combined O&M cost is based on the formula, Initial Investment x 0.035.
(4) All costs reported in plant visit log include both air and water treatment costs and as such cannot be used in this table.
(5) Combined treatment cost over a number of years was only cost supplied. Based on a review of installation dates as provided in the 308, the following apportionment was devised: 75% of total cost in 1951 and 25% in 1971. The cost contributed by sintering was based on the proportion of sintering flow (850 gpm) to total flow (14,400 gpm).
(6) Based on the flow proportions discussed in item (5).
(7) Company based cost of capital and depreciation amounts.
(8) Operating costs are based on formula in (3) because costs supplied include operating expense of air pollution control equipment.
(9) Tonnage is based on plant visit or D-DCP data.

TABLE VIII-2

CONTROL AND TREATMENT TECHNOLOGIES
SINTERING SUBCATEGORY

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
A. Thickener - This step provides suspended solids removal via sedimentation. The oils are also allowed to surface and are skimmed.	Widely used in this subcategory and in various wastewater treatment operations throughout the steel industry and other industries.	Accumulated solids must be removed continuously or quite frequently to prevent damage to thickener mechanical equipment. Hydraulic surges must be controlled.	15-18 months	105' x 210'	Proper solids and skimmed oil disposal is required.	The solid waste generation rate for the treatment model, on the basis of dry solids is 732 lb/ton (147 ton/day, 53,800 ton/year). These solids consist primarily of the metal oxides (principally iron) which comprise the process dusts. The quantities of oils and greases removed via skimming and entrainment with the solids is 2.86 lb/ton (5.72 ton/day, 2089 ton/year) for the treatment model.
B. Polymer Addition - Polymer addition is incorporated to enhance suspended solids removal performance.	Widely used in this subcategory and in other industrial wastewater treatment applications.	Dissolved solids level will be slighlty increased.	6 months	25' x 25'	The additional solids removal accomplished via polymer addition must receive proper disposal.	Included with Step A.
C. Vacuum Filter - Used to dewater the sludges removed from the thickener.	Widely used in this subcategory and in other industry wastewater treatment applications.	Routine maintenance of the vacuum pumps and filter mechanism is required. The filter media must be replaced periodically.	15-18 months	50'x120'	The dewatered solids must receive proper disposal.	Refer to Step A.

TABLE VIII-2
CONTROL AND TREATMENT TECHNOLOGIES
SINTERING SUBCATEGORY
PAGE 2

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
D. Recycle - 93% of the thickener effluent is recycled to the process.	Demonstrated in this subcategory (refer to Section IX).	The potential exists for scaling and plugging due to the increased dissolved solids levels associated with recycle systems.	12 to 14 months	20'x30'	None	None
E. pH Adjustment With Acid - The pH of the system effluent is adjusted to the neutral range using acid.	Widely used in various industrial wastewater treatment applications. pH control systems require routine calibration and maintenance.	Caution must be exercised in the handling and storing of the acid.	8 to 10 months	20'x20'	Acid fumes must be properly vented and exhausted.	None
F. Increase Recycle Rate to 95% - Provisions are incorporated to increase the recycle rate and thus reduce the treatment system effluent flow.	Demonstrated in this subcategory as noted in Section X.	The potential exists for scaling and plugging due to the increased dissolved solids levels associated with recycle systems.	12 to 14 months	No additional land required. Included in in Step D.	None	None
G. Filtration - Filters are used to provide additional suspended solids removal.	Used in this subcategory and demonstrated in other wastewater treatment applications.	Hydraulic overloads must be controlled. Inadequate solids removal performance in previous steps will impede efficient filter operation.	15 to 18 months	20'x25'	The backwash solids and oils and greases must receive proper disposal.	The backwash solids represent an additional solids generation rate, on a dry basis of 0.022 lb/ton (87.6 lb/day, 16.0 ton/year). These solids are similar in nature to the solids removed in step A. This step will also provide a reduction in the oil and grease load. The additional load of oils and greases removed is 0.003 lb/ton (12.5 lb/day, 2.28 ton/year).

TABLE VIII-2
CONTROL AND TREATMENT TECHNOLOGIES
SINTERING SUBCATEGORY
PAGE 3

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
H. Lime Addition - Used in conjunction with steps I and K for the purposes of providing additional toxic metals removal capabilities and to increase the pH needed for alkaline chlorination.	Used in this subcategory and in other industrial wastewater treatment applications.	The lime feed and mixing systems require periodic cleaning and maintenance.	12 months	15' x 15'	Dust control while unloading the lime must be provided.	Included in Step J.
I. Sulfide Precipitation - A source of sulfide is added to the wastewater stream to form metallic sulfide precipitates which are subsequently removed via filtration. Sulfide also serves as a declorination agent.	Used in various industrial wastewater treatment operations for the purpose of providing additional toxic metals removal.	Care must be exercised in the handling and use of the feed solution. Tight treatment process control is desirable.	6 months	15' x 15'	The resultant metal sulfide precipitates require proper disposal. Sulfide odors can result if inadequate treatment process control is provided.	The metal sulfide precipitates, which are removed in the filtration step (Step G), generate a quite minimal additional solids load.
J. Clarifier - Provides for the removal of the suspended solids generated as a result of lime addition. This step is used in conjunction with steps H and K.	Gravity sedimentation capabilities are demonstrated widely in this subcategory and in other industrial wastewater treatment operations.	Accumulated solids must be regularly removed to prevent damage to the clarifier mechanical equipment. Hydraulic surges must be controlled.	15 to 18 months	35' x 35'	Proper solids disposal is required.	This step results in an additional solids generation rate, on a dry solids basis, of 0.075 lb/ton (300 lb/day, 54.8 ton/year) for the treatment model. These solids consist of lime and its precipitates, principally fluoride. These solids are dewatered by the vacuum filter, step C.

TABLE VIII-2
CONTROL AND TREATMENT TECHNOLOGIES
SINTERING SUBCATEGORY
PAGE 4

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation and Primary Constituents
K. Alkaline Chlorination - Chlorine is added in conjunction with step H (lime addition) for the purpose of oxidizing cyanide. Preliminary phenols oxidation is also accomplished.	This technology is used in two central treatment systems which receive sintering process wastewaters. In addition, this technology is also used in other wastewater treatment applications in other subcategories and industries.	Extreme caution must be exercised in the handling of chlorine gas. Instrumentation controlling chlorine feed must receive periodic maintenance.	6 months	10' x 10'	Chlorine and its volatile derivatives can be lost to the atmosphere.	Included in Step J.
L. Activated Carbon Treatment - The treated effluent is passed through granular activated carbon columns for the purpose of removing residual toxic organic pollutants. These pollutants are removed via adsorption on the activated carbon.	Used in various industrial wastewater treatment applications.	The carbon must be periodically regenerated and losses replaced. Excess suspended solids in the influent could plug the carbon column. Careful process monitoring is required.	15 to 18 months	20' x 25'	Substantial amounts of energy are required for carbon regeneration.	Virtually nil.

TABLE VIII-3

BPT MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Sintering

Model Size-TPD : 4000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	A(3)	B	C(3)	D	E	Total
Investment \$ x 10^{-3}	1580	90	1444	587	142	3843
Annual Cost \$ x 10^{-3}						
Capital	68.0	3.9	62.1	25.2	6.1	165.3
Depreciation	158.0	9.0	144.4	85.7	14.2	384.3
Operation & Maintenance	55.3	3.2	50.6	20.5	5.0	134.6
Sludge Disposal	-	-	896.1	-	-	896.1
Energy and Power(1)	3.3	0.7	80.5	32.7(2)	1.0	85.5
Chemical Costs	-	63.7	-	-	3.2	66.9
Oil Disposal	41.8	-	-	-	-	41.8
TOTAL	326.4	80.5	1233.7	104.4(2)	29.5	1774.5

Wastewater Parameters	Raw Waste Loads(4)	BPT Effluent Level
Flow, gal/ton	1460	100
pH (Units)	6-12	6-9
Concentrations, mg/l		
Cyanide (T)	0.20	0.5
Phenols (4AAP)	0.20	1.0
Fluoride	6	30
Oil and Grease	245	10
Suspended Solids	6100	50
39 Fluoranthene	0.01	0.10
65 Phenol	0.01	0.05
76 Chrysene	0.01	0.01
84 Pyrene	0.01	0.01
118 Cadmium	0.20	0.20
119 Chromium	0.70	0.50
120 Copper	0.10	0.10
122 Lead	0.60	0.50
124 Nickel	0.30	0.50
126 Silver	0.20	0.20
128 Zinc	1.00	0.50

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(1) Costs are all power unless otherwise noted.

(2) Total does not include power cost, as a credit is supplied for existing process water power requirements.

(3) Treatment components are used in tandem.

(4) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant Aid Addition
C: Vacuum filter
D: Recycle 93%
E: pH adjustment with acid

TABLE VIII-4

BPT CAPITAL COST TABULATION
BASIS: 7/1/78 DOLLARS x 10^{-3}
FACILITIES IN PLACE AS OF 1/1/78

Subcategory: SINTERING

Plant Code	TPD	C&TT Step A	B	C	D	E	In-Place	Required	Total
0060	2,640	1,232	70	1,126	457	111	1,870	1,126	2,996
0060B	2,400	1,163	66	1,063	432	-	2,724	0	2,724
0060F	1,360	827	47	756	307	74	1,255	756	2,011
0112A	12,200	3,085	176	2,820	296-850	277	6,478	1,026	7,504
0112B	4,000	1,580	90	1,444	587	142	1,580	2,263	3,843
0112C	2,683	1,244	71	1,137	194-268	112	2,687	339	3,026
0112D	6,070	2,030	116	1,855	754	182	4,937	0	4,937
0396A	3,312	1,411	81	1,290	524	127	3,306	127	3,433
0432A	6,500	2,115	121	1,933	785	190	4,169	975	5,144
0448A	3,850	1,544	88	-	573	139	2,117	227	2,344
0492A	1,900	1,011	58	924	375	91	1,386	1,073	2,459
0584C	3,800	1,532	88	1,401	569	138	2,933	795	3,728
0584F	8,187	2,429	139	2,220	902	218	2,429	3,479	5,908
0856F	7,200	2,249	128	2,055	835	202	2,249	3,220	5,469
0856Q	500	454	-	415	169	-	1,038	0	1,038
0864A	2,910	1,306	75	1,193	485	117	1,498	1,678	3,176
0868A	7,783	2,356	135	2,153	875	211	0	5,730	5,730
0920B	1,000	688	39	629	255	62	1,356	317	1,673
0920F	1,500	877	50	802	326	79	1,282	852	2,134
0946A	540	475	27	434	109-67	43	1,045	110	1,155
0948C	4,000	1,580	90	1,444	587	142	0	3,843	3,843
							46,339	27,936	74,275

NOTE: Underlined costs represent facilities in place. Where two figures appear in the same column, the underlined portion is in place; the non-underlined portion remains to be installed.

Legend

A: Thickener
B: Coagulant Aid Addition
C: Vacuum Filter
D: Recycle 93%
E: pH Adjustment with Acid

TABLE VIII-5

ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Sintering

Model Size-TPD : 4000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Steps	BAT No. 1(3)			BAT No. 2(3)					BAT No. 3(3)			BAT No. 4(3)		
	F	G	Total	F,G	H	I	J	Total	F,G,H,I,J	K	Total	F,G,H,I,J,K	L	Total
Investment $ x 10^{-3}	26	217	243		78	81	163	565		66	631		1904	2535
Annual Costs $ x 10^{-3}														
Capital	1.1	9.3	10.4		3.3	3.5	7.0	24.2		2.8	27.0		81.9	108.9
Depreciation	2.6	21.7	24.3		7.8	8.1	16.3	56.5		6.6	63.1		190.4	253.5
Operation and Maintenance	0.9	7.6	8.5		2.7	2.8	5.7	19.7		2.3	22.0		66.6	88.6
Sludge Disposal	-	-	-		-	-	0.3	0.3		-	0.3		-	0.3
Energy and Power(1)	0.3(2)	1.4	1.4		1.0	0.8	0.8	4.0		0.4	4.0		8.2	12.6
Chemical Costs	-	-	-		1.6	1.9	-	3.5		3.4	6.9		-	6.9
Carbon Regeneration	-	-	-		-	-	-	-		-	-		469.0	469.0
TOTAL	4.6(2)	40.0	44.6		16.4	17.1	30.1	108.2		15.5	123.7		816.1	939.8

Wastewater Parameters	BAT Feed Level	BAT No.1 Effluent Level	BAT No.2 Effluent Level	BAT No.3 Effluent Level	BAT No.4 Effluent Level
Flow, gal/ton	100	75	75	75	75
pH (Units)	6-9	6-9	6-9	6-9	6-9
Concentrations, mg/l					
Cyanide (T)	0.5	0.5	0.5	0.25	0.25
Phenols (4AAP)	1.0	2.0	2.0	0.10	0.05
Fluoride	30	30	10	10	10
Chlorine (Residual)	-	-	-	0.5	0.5
Oil and Grease	10	5	5	5	5
Suspended Solids	50	15	15	15	15
39 Fluoranthene	0.10	0.10	0.10	0.10	0.01
65 Phenol	0.05	0.05	0.05	0.05	0.05
76 Chrysene	0.01	0.01	0.01	0.01	0.01
84 Pyrene	0.01	0.01	0.01	0.01	0.01

TABLE VIII-5
ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS
SUBCATEGORY: SINTERING
PAGE 2

Wastewater Parameters	BAT Feed Level	BAT No.1 Effluent Level	BAT No.2 Effluent Level	BAT No.3 Effluent Level	BAT No.4 Effluent Level
118 Cadmium	0.20	0.10	0.10	0.10	0.10
119 Chromium	0.35	0.10	0.10	0.10	0.10
120 Copper	0.10	0.10	0.10	0.10	0.10
122 Lead	0.35	0.10	0.10	0.10	0.10
124 Nickel	0.35	0.10	0.10	0.10	0.10
126 Silver	0.20	0.10	0.10	0.10	0.10
128 Zinc	0.35	0.10	0.10	0.10	0.10

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for existing process water requirements.
(3) Acid pH adjustment step is moved from BPT to BAT, however, no cost is applied as this step is provided at BPT.

KEY TO C&TT STEPS

F: Increase recycle rate to 95%
G: Filtration
H: Lime addition
I: Sulfide addition
J: Clarifier
K: Alkaline chlorination
L: Granular activated carbon columns

TABLE VIII-6

RESULTS OF BCT COST TEST
SINTERING SUBCATEGORY

A. BCT Feed

Effluent concentration of conventional pollutants = 60 mg/l
Flow = 0.40 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 73,058

B. BCT-1

Effluent concentration of conventional pollutants = 20 mg/l
Flow = 0.30 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 18,265

lbs/Year of conventional pollutants removed via BCT treatment
73,058 - 18,265 = 54,793

Annual cost of BCT-1 = $44,600* $/lb = 0.81 PASS

C. BCT-2

Effluent concentration of conventional pollutants = 20 mg/l
Flow = 0.30 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 18,265

lbs/Year of conventional pollutants removed via BCT treatment
73,058 - 18,265 = 54,793

Annual cost of BCT System = $74,700* $/lb = 1.36 FAIL

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*: Includes only the recycle, clarification, and filtration steps.

TABLE VIII-7

NSPS AND PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Sintering

Model Size-TPD : 7000
Oper. Days/Year: 365
Turns/Day : 3

Alternative	NSPS and PSNS Alternative No. 1							NSPS and PSNS Alternative No. 2				
C&TT Step	A(3)	B	C(3)	D	E	F	Total	A-F	G	H	I	Total
Investment $ x 10^{-3}	2260	106	2843	875	269	130	6483		114	128	226	6951
Annual Costs $ x 10^{-3}												
Capital	97.2	4.6	122.2	37.6	11.6	5.6	278.8		4.9	5.5	9.7	298.9
Depreciation	226.0	10.6	284.3	87.5	26.9	13.0	648.3		11.4	12.8	22.6	695.1
Operation and Maintenance	79.1	3.7	99.5	30.6	9.4	4.6	226.9		4.0	4.5	7.9	243.3
Sludge Disposal	-	-	1580.5	-	-	-	1580.5		-	-	-	1580.5
Energy and Power(1)	6.5	2.0	162.2	49.0(2)	2.6	1.0	174.3		1.6	1.5	0.8	178.2
Chemical Costs	-	112.3	-	-	-	4.2	116.5		2.8	3.3	-	122.6
Oil Disposal	73.2	-	-	-	-	-	73.2		-	-	-	73.2
Carbon Regeneration	-	-	-	-	-	-	-		-	-	-	-
TOTAL	482.0	133.2	2248.7	155.7(2)	50.5	28.4	3098.5		26.7	27.6	41.0	3191.8

Wastewater Parameters	Raw(4) Waste Load	NSPS and PSNS No.1 Effluent Level	NSPS and PSNS No.2 Effluent Level
Flow, gal/ton	1460	75	75
pH (Units)	6-12	6-9	6-9
Concentration, mg/l			
Cyanide (T)	0.20	0.5	0.5
Phenols (4AAP)	0.20	2.0	2.0
Fluoride	6	30	10
Chlorine (Residual)	-	-	-
Oil and Grease	265	5	5
Suspended Solids	6100	15	15

TABLE VIII-7
NSPS AND PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: SINTERING
PAGE 2

Wastewater Parameters		Raw$^{(4)}$ Waste Load	NSPS and PSNS No. 1 Effluent Level	NSPS and PSNS No. 2 Effluent Level
39	Fluoranthene	0.01	0.10	0.10
65	Phenol	0.01	0.05	0.05
76	Chrysene	0.01	0.01	0.01
84	Pyrene	0.01	0.01	0.01
118	Cadmium	0.20	0.10	0.10
119	Chromium	0.70	0.10	0.10
120	Copper	0.10	0.10	0.10
122	Lead	0.60	0.10	0.10
124	Nickel	0.30	0.10	0.10
126	Silver	0.20	0.10	0.10
128	Zinc	1.00	0.10	0.10

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for process water requirements.
(3) Treatment components are used in tandem.
(4) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant aid addition
C: Vacuum filter
D: Recycle 95%
E: Filtration
F: Neutralization with acid

G: Lime addition
H: Sulfide addition
I: Clarifier
J: Alkaline chlorination
K: Granular Activated Carbon Columns

TABLE VIII-7
NSPS AND PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: SINTERING
PAGE 3

Alternative	NSPS and PSNS Alternative No. 3			NSPS Alternative No. 4		
C&TT Step	A-I	J	Total	A-J	K	Total
Investment $ x 10^{-3}		94	7043		2382	9427
Annual Cost $ x 10^{-3}						
Capital		4.0	302.9		102.4	405.3
Depreciation		9.4	704.5		238.2	942.7
Operation and Maintenance		3.3	246.6		83.4	330.0
Sludge Disposal		-	1580.5		-	1580.5
Energy and Power(1)		0.7	178.9		12.2	191.1
Chemical Costs		6.0	128.6		-	128.6
Oil Disposal		-	73.2		-	73.2
Carbon Regeneration		-	-		586.2	586.2
TOTAL		23.4	3215.2		1022.4	4237.6

	Raw(4) Waste Load	NSPS and PSNS No.3 Effluent Level	NSPS No.4 Effluent Level
Flow, gal/ton	1460	75	75
pH (Units)	6-12	6-9	6-9
Concentration, mg/l			
Cyanide (T)	0.20	0.25	0.25
Phenols (4AAP)	0.20	0.10	0.05
Fluoride	6	10	10
Chlorine (Residual)	-	0.5	0.5
Oil and Grease	245	5	5
Suspended Solids	6100	15	15

TABLE VIII-7
NSPS and PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: SINTERING
PAGE 4

Wastewater Parameters	Raw(4) Waste Load	NSPS and PSNS No. 3 Effluent Level	NSPS and PSNS No.4 Effluent Level
39 Fluroanthene	0.01	0.10	0.01
65 Phenol	0.01	0.05	0.05
76 Chrysene	0.01	0.01	0.01
84 Pyrene	0.01	0.01	0.01
118 Cadmium	0.20	0.10	0.10
119 Chromium	0.70	0.10	0.10
120 Copper	0.10	0.10	0.10
122 Lead	0.60	0.10	0.10
124 Nickel	0.50	0.10	0.10
126 Silver	0.20	0.10	0.10
128 Zinc	1.00	0.10	0.10

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for process water requirements.
(3) Treatment components are used in tandem.
(4) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant aid addition
C: Vacuum filter
D: Recycle 95%
E: Filtration
F: Neutralization with acid
G: Lime addition
H: Sulfide addition
I: Clarifier
J: Alkaline chlorination
K: Granular Activated Carbon Columns

TABLE VIII-8

PSES MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Sintering

Model Size-TPD : 4000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	PSES Alternative No. 1								PSES Alternative No. 2					PSES Alternative No. 3	
	A(3)	B	C(3)	D	E	F	Total	A-F	G	H	I	Total	A-I	J	Total
Investment $ x 10^{-3}	1580	90	1444	588	217	97	4016		78	81	163	4338		66	4404
Annual Cost $ x 10^{-3}															
Capital	68.0	3.9	62.1	25.3	9.3	4.2	172.8		3.3	3.5	7.0	186.6		2.8	189.4
Depreciation	158.0	9.0	144.4	58.8	21.7	9.7	401.6		7.8	8.1	16.3	433.8		6.6	440.4
Operation and Maintenance	55.3	3.2	50.6	20.6	7.6	3.4	140.7		2.7	2.8	5.7	151.9		2.3	154.2
Sludge Disposal	-	-	896.1	-	-	-	896.1		-	-	0.3	896.4		-	896.4
Energy and Power(1)	3.3	0.7	80.5	32.7(2)	1.4	0.7	86.6		1.0	0.8	0.8	89.2		0.4	89.6
Chemical Costs	-	63.7	-	-	-	2.4	66.1		1.6	1.9	-	69.6		3.4	73.0
Oil Disposal	41.8	-	-	-	-	-	41.8		-	-	-	41.8		-	41.8
TOTAL	326.4	80.5	1233.7	104.7(2)	40.0	20.4	1805.7		16.4	17.1	30.1	1869.3		15.5	1884.8

Wastewater Parameters	Raw(4) Waste Load	PSES No. 1 Effluent Level	PSES No. 2 Effluent Level	PSES No. 3 Effluent Level
Flow, gal/ton	1460	75	75	75
pH (Units)	6-12	6-9	6-9	6-9
Concentrations, mg/l				
Cyanide (T)	0.20	0.5	0.5	0.25
Phenols (4AAP)	0.20	2.0	2.0	0.10
Fluoride	6	30	10	10
Chlorine (Residual)	-	-	-	0.5
Oil and Grease	245	5	5	5
Suspended Solids	6100	15	15	15
39 Fluoranthene	0.01	0.10	0.10	0.05
65 Phenol	0.01	0.05	0.05	0.05
76 Chrysene	0.01	0.01	0.01	0.01
84 Pyrene	0.01	0.01	0.01	0.01

TABLE VIII-8
PSES MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: SINTERING
PAGE 2

Wastewater Parameters	Raw[4] Waste Load	PSES No. 1 Effluent Level	PSES No. 2 Effluent Level	PSES No. 3 Effluent Level
118 Cadmium	0.20	0.10	0.10	0.10
119 Chromium	0.70	0.10	0.10	0.10
120 Copper	0.10	0.10	0.10	0.10
122 Lead	0.60	0.10	0.10	0.10
124 Nickel	0.50	0.10	0.10	0.10
126 Silver	0.20	0.10	0.10	0.10
128 Zinc	1.00	0.10	0.10	0.10

---

(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for process water requirements.
(3) Treatment components are used in tandem.
(4) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant aid addition
C: Vacuum filter
D: Recycle 95%
E: Filtration
F: Neutralization with acid
G: Lime Addition
H: Sulfide addition
I: Clarifier
J: Alkaline chlorination

SINTERING SUBCATEGORY

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

The Agency is proposing limitations for Best Practicable Control Technology Currently Available (BPT) different than those originally promulgated in June 1974[1] for sintering operations. The limitations have been adjusted to accommodate all sintering wastewater sources. The limitations promulgated in 1974 did not take into account wastewaters from raw material handling air pollution control systems. As the June 1974 development document[2] described the basic methods used in developing the previous effluent limitations, the intent of this section is to provide substantiation of the proposed effluent limitations. A review of the treatment processes and effluent limitations associated with the sintering subcategory follows.

Identification of BPT

The Agency decided to use the original BPT model treatment system as the model treatment system for the proposed BPT limitations. Suspended solids are removed from process wastewaters by gravity sedimentation in a thickener. A polymeric flocculant is added to the thickener influent to optimize the removal of suspended solids. The thickener underflow is dewatered in a vacuum filter, and the filtrate returned to the thickener inlet. About 93% of the thickener overflow is returned to the sintering operation. The pH of the generally alkaline treatment system blowdown is adjusted to the neutral pH range with acid. Oils and greases are removed by surface skimming in the thickener and also by entrainment within the solids which settle in the thickener. This treatment system is depicted in Figure IX-1.

As noted previously, the proposed limitations do not require the installation of the model treatment system. Any treatment system which achieves compliance with the limitations is appropriate.

The proposed BPT limitations are based upon the same effluent concentrations used in developing the originally promulgated limitations. However, data recently collected indicate that the model effluent flow should be increased from 208 l/kkg (50 gal/ton) to 417 l/kkg (100 gal/ton). As the model effluent flow has been doubled, the proposed effluent limitations were also doubled. The proposed 30-day average BPT effluent limitations are presented below:

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[1] Federal Register; Friday, June 28, 1974; Part II, Environmental Protection Agency; Iron and Steel Manufacturing Point Source Category; Effluent Guidelines and Standards; Pages 24114-24133.

[2] EPA 440/I-74-024-a, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category.

	kg/kkg of Product (lb/1000 lb of Product)
Suspended Solids	0.0208
Oil and Grease	0.0042
pH (Units)	6.0 to 9.0

The maximum daily effluent limitations are proposed at three times the 30-day average.

Rationale for BPT

Treatment System

As noted in Section VII, the components of the BPT model treatment system are presently in use at most sintering operations.

Table IX-1 presents a summary of the flow, recycle rate, and operating data for this subcategory. The original model effluent flow was based upon data from one sintering operation which generated wastewater from only the discharge end (sinter cooling, crushing, and screening) of the process. However, as wastewater discharges originate at numerous points in the sintering operation (refer to Section III), the Agency increased the model effluent flow to accomodate all wastewater sources. Table IX-1 not only provides support for the model effluent flow of 100 gal/ton, but also shows that the treatment system recycle rate of 93% (defined by the applied and effluent flows) is demonstrated. It should be noted that those flows averaged to develop the model effluent flow are for plants which have one or more process wastewater source.

Justification of the Proposed BPT Effluent Limitations

Table IX-2 presents effluent loads calculated for two of the surveyed plants. These results support the proposed BPT limitations. The Agency surveyed other plants, however, at one plant the actual sintering treatment system effluent was a thickener underflow while at another plant it was solids laden wastewater from the bottom of a moisture eliminator. Both of these effluents were discharged to another wastewater treatment system for additional treatment. Had these wastewaters followed a more conventional treatment path, i.e., discharge of a thickener overflow instead of the underflow, compliance with the adjusted effluent limitations would be demonstrated. This observation is based upon the analytical data obtained at these plants. At another surveyed plant, sintering process wastewaters were combined with other wastewaters, treated,and discharged. This plant did not recycle any of its sintering wastewaters.

TABLE IX-1

BPT FLOW SUMMARY AND JUSTIFICATION
SINTERING SUBCATEGORY

Plant Code	Applied Flow (gal/ton)	Discharge Flow (gal/ton)	Operating Mode	Origin of Process Wastewaters	Basis
0448A	UNK	0*	RTP-100	B	DCP
0060F	301	26*	RTP-91	A	VISIT
0868A	100	70*	RTP-30	D	DCP
0920F	2124	74*	RTP and RUP-94	A	D-DCP
0396A	341	80*	RTP-75	B	VISIT
0584F	106	106	OT	C	DCP
0856Q	2805	117*	RTP-96	A	DCP
0112B	133	133*	OT	C	DCP
0920B	134	134*	OT	C	DCP
0948C	1124	135*	RUP-88	A	DCP
0112D	1432	142*	RTP-90	A	VISIT
0060	1667	219	RTP and RUP-80	C	D-DCP
0856F	220	220	OT	B	D-DCP
0432A	245	245	OT	C	VISIT
0112A	1604	288	RTP and RUP-77	C	D-DCP
0112C	1292	793	RTP-39	B	DCP
0584C	1368	1368	OT	A	DCP
0864A	2819	1733	RTP-38	A	D-DCP
0060B	2186	2186	OT	C	DCP
0492A	2582	2582	OT	C	DCP
0946A	6605	6605	OT	A	DCP

A: Machine end of operation.
B: Discharge end of operation.
C: Both ends of operation.
D: Contact cooling of the product only.

*: Denotes those plants used to determine the BPT treatment model effluent flow.

NOTE: The distinct break in the ascending order of recycle flows between 142 gal/ton and 219 gal/ton indicated that those effluent flows less than or equal to 142 gal/ton would be used to determine the "average of the best flows."

TABLE IX-2

EFFLUENT LOADS (lb/1000 lb) JUSTIFICATION
SINTERING SUBCATEGORY

	Discharge Flow (gal/ton)	Suspended Solids	Oil and Grease	pH	C&TT Components
Adjusted Effluent Limitations(1)	100	0.0208	0.0042	6-9	FLP>T>VF>RTP-93, NA
BPT Effluent Limitations (6/74)	50	0.0104	0.0021	6-9	FLP>T>VF>RTP-93, NA
Actual Loads					
J (0396A)	80	0.0032	0.00027	12.8	FLP>CL>CT>VF>RTP-75
0920F(2)	74	0.017	0.0043	8.1	NC>CL, RTP-4, RUP-90

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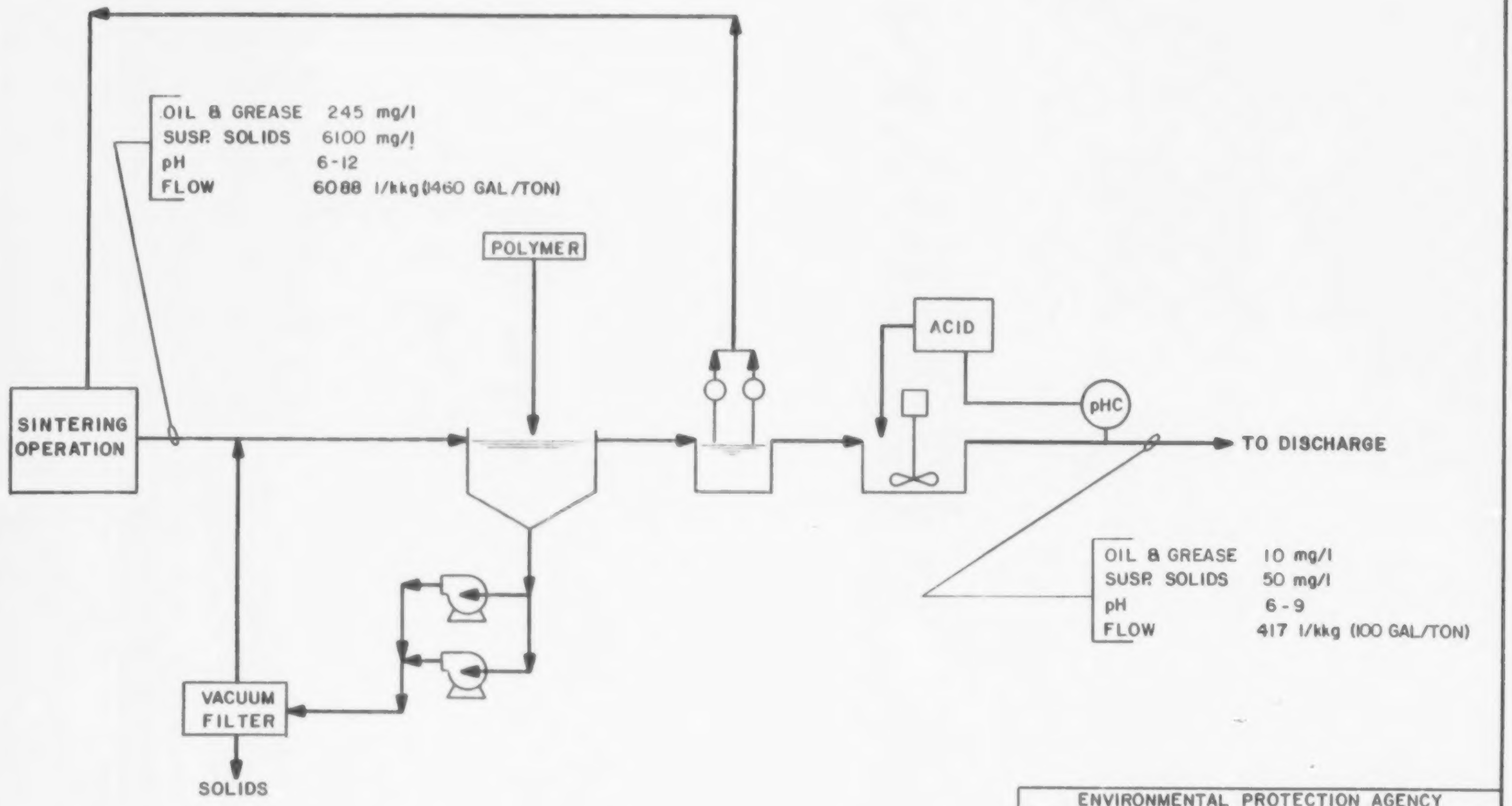
(1) These loads represent the originally promulgated loads adjusted to accommodate recently acquired data.
(2) This data represents long-term effluent averages provided in this plant's D-DCP response.


OIL & GREASE 245 mg/l
SUSP. SOLIDS 6100 mg/l
pH 6-12
FLOW 6088 l/kkg (1460 GAL/TON)
SINTERING OPERATION
POLYMER
VACUUM FILTER
SOLIDS
ACID
pHC
TO DISCHARGE
OIL & GREASE 10 mg/l
SUSP. SOLIDS 50 mg/l
pH 6-9
FLOW 417 l/kkg (100 GAL/TON)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
BPT TREATMENT MODEL
DWN. 1/10/79
FIGURE IX-1

SINTERING SUBCATEGORY

SECTION X

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

The Best Available Technology Economically Achievable (BAT) effluent limitations are to be achieved by July 1, 1984. BAT is determined by reviewing subcategory practices and identifying the best economically achievable control and treatment technology employed within the subcategory. In addition, where a treatment technology is readily transferable from another subcategory or industry, such technology may be identified as BAT.

This section identifies four BAT treatment alternatives which the Agency considered for the sintering subcategory. In addition, the rationale for selecting the BAT model treatment system flow rates and raw and effluent pollutant concentrations are reviewed. Finally, the rationale for selecting the BAT model treatment system is discussed.

Identification of BAT

Based upon the information contained in Sections III through VIII, the following alternative treatment systems were developed as add-ons to the BPT model treatment system.

1. BAT Alternative No. 1

   In the first BAT Alternative, the blowdown flow is reduced from the model BPT flow rate of 100 gal/ton to 75 gal/ton by increasing the recycle flow. The level of toxic metals and suspended solids in the blowdown are reduced using filtration technology. The pH of the effluent is adjusted using acid. This step is a BPT component which has been relocated in the sequence of treatment steps.

2. BAT Alternative No. 2

   BAT Alternative No. 2 retains the treatment components of the first alternative and adds the following treatment components prior to filtration: (1) Lime is added to the recycle system blowdown as an aid to precipitate formation and for the purpose of pH adjustment; (2) Some of the solids generated as a result of lime addition, in addition to some of the suspended solids present in the blowdown, are removed by sedimentation in a clarifier; (3) The clarifier underflow is dewatered with the vacuum filter included in the BPT model treatment system; and, (4) Sulfide precipitation is then applied to the clarifier effluent before filtration. The above steps are aimed at achieving a higher degree of toxic metals removal than that which could be accomplished solely through filtration.

3. BAT Alternative No. 3

   This alternative incorporates the treatment system components of BAT Alternative No. 2, and adds alkaline chlorination prior to clarification. Alkaline chlorination is included for the purposes of oxidizing cyanide, phenols, and other toxic organic pollutants. The chlorinated effluent is clarified, filtered and then dechlorinated with an appropriate reducing agent.

4. BAT Alternative No. 4

   The fourth BAT alternative treatment system incorporates the treatment system components of BAT Alternative No. 3 and adds adsorption on granular activated carbon for removal of toxic organic pollutants as the final treatment step prior to discharge.

Figure X-1 illustrates the four BAT alternative treatment systems described above. The treatment technologies represent those technologies in use at one or more plants, or demonstrated in other wastewater treatment applications in the industry.

The BAT effluent levels for the pollutants limited at BPT and considered for limitation at BAT are presented in Table X-1. The Agency's selection of those pollutants for which limitations are proposed is based upon the following considerations: (1) the relative level, load, and environmental impact of each pollutant; (2) the need to establish practical monitoring requirements; and, (3) the ability of the selected pollutants to serve as "indicator" pollutants (as discussed in Section V of Volume I).

While other toxic metal pollutants were found in sintering wastewaters, (at lower levels than lead or zinc), control of lead and zinc should result in the comparable control of other toxic metals. Likewise, treatment for phenols (4AAP) will result in reductions in the levels and loads of those toxic organic pollutants which are chemically related to phenols (4AAP). Cyanide is included because of its presence in the sampled plant wastewaters at significant levels. Ammonia-N was selected as a limited pollutant since it appeared in significant levels at one plant and in order to make the sintering and ironmaking regulations compatible with each other for co-treatment systems. Based upon the observations noted above, phenols, cyanide (total), ammonia-N, lead and zinc were selected for limitation at BAT. Investment and annual costs for the BAT alternative treatment systems are presented in Section VIII.

Rationale for the Selection of BAT

Treatment Technologies

The model BAT applied and discharge flows are based upon a recycle rate of 95%. Referring to Table IX-1, the average and individual recycle rates of the five plants used to develop the model BAT effluent flow support a 95% recycle rate. The Agency has included filtration in all of the model BAT treatment systems to achieve reductions in toxic metals effluent loads. These toxic metals level reductions are accomplished by the removal of suspended solids from the wastewaters in which the metals are entrained. Three of the 20 "wet" sintering plants use filtration (as part of central wastewater treatment systems). Filtration is also used extensively in other steel industry subcategories (e.g., blast furnace, basic oxygen furnace, continuous casting, and hot forming), and by other industries for the removal of suspended particulate matter from similar wastewater streams.

Lime addition for the purpose of pH adjustment and precipitate formation is a common wastewater treatment practice. The use of clarifiers for wastewater sedimentation is common in this subcategory and in a wide variety of other subcategories and industries.

The alternatives also include sulfide precipitation, in conjunction with filtration, for the purpose of providing optimum reductions in toxic metals effluent levels and loads. While much of the toxic metals waste load is entrained in the suspended solids (and will, therefore, be removed by filtration), the remaining portion of the toxic metals load is dissolved in the process wastewaters. These dissolved metals will generally remain after filtration. Accordingly, the Agency added sulfide precipitation to control this dissolved toxic metals load. Although not presently in use in sintering wastewater treatment systems, the effectiveness of this treatment technology has been demonstrated in pilot studies and in wastewater treatment applications in other metals manufacturing operations.

Alkaline chlorination is incorporated as a means of controlling cyanide, ammonia-N, and phenols and other toxic organic pollutant levels. The treatment capabilities of the alkaline chlorination process result directly from the use of the strong oxidizing agent, chlorine. As part of their central wastewater treatment facilities, two plants in this subcategory use alkaline chlorination treatment technology. Dechlorination using reducing agents is added to control excess residual chlorine.

Activated carbon adsorption is included to remove any toxic organic pollutants which may remain after treatment by alkaline chlorination. Although activated carbon is not currently used in any sinter plant applications, the applicability and effectiveness of this technology to sinter plant wastes is based on pilot plant studies for the ironmaking subcategory and on the basis of the performance of a by-product cokemaking full scale activated carbon treatment system. These capabilities are discussed more fully in Volume I.

Flows

Refer to Table IX-1 for the data used to develop the model BAT treatment system effluent flow. The reduction in treatment system effluent flow (recycle blowdown) used for the BAT model treatment system is based upon the average of the effluent flows of those five plants which have recycle rates of 90% or more. The plants which have recycle rates of 90% or more approach or exceed the model BPT recycle rate of 93%. It should be noted that the effluent flow of plant 0396A closely approaches the BAT treatment model effluent flow. It should also be noted that three of the five plants had blowdown flows less than that of the model. In fact, one plant has no wastewater discharge and the effluent flow from another plant is substantially lower than the model effluent flow. Accordingly, the Agency believes that a recycle rate of 95% is appropriate for the BAT model treatment systems.

Wastewater Quality

Refer to the discussion presented previously in this section regarding the development of the list of pollutants considered for limitation and to Table X-1 for a tabulation of these pollutants and their associated effluent levels and loads.

Toxic Metals Pollutants

To determine the effluent concentrations for the toxic metal pollutants, the Agency evaluated analytical data from several sources. The Agency reviewed long-term filtration system effluent data to determine the toxic metals removal capabilities of filtration systems used in similar wastewater treatment applications. A review of these data indicate that the suspended solids contain most of the toxic metals. Therefore, in those instances where the long-term analytical data (noted above and discussed in more detail in Volume I) could not be directly applied to sintering process wastewater filtration applications, toxic metals removals approximated the degree of suspended solids removal accomplished. The sampled plant analytical data presented in Section VII demonstrate this pattern. The toxic metals effluent concentrations incorporated at BAT are based upon total metals and are supported by the sampled plant data presented in Section VII and the long-term data presented in Volume I.

In order to ensure the optimum toxic metals level reductions, in process wastewaters, sulfide precipitation and lime addition are incorporated prior to and in conjunction with the filtration component.

While sulfide precipitation technology has not been demonstrated within this subcategory, the capabilities of this technology with respect to toxic metals precipitation may be transferred on the basis of its effectiveness in other metals manufacturing processes and in pilot studies. A review of this data is presented in Volume I.

Sulfide addition was considered as a means of reducing the toxic metals effluent levels. However, since this technology has not been demonstrated in this subcategory, due to potential operating problems, and the marginal incremental metals removal, the Agency did not select sulfide precipitation as a BAT technology. Sulfide addition, or the addition of other suitable reducing agents, can be used to effectively control excess residual chlorine following alkaline chlorination. The cost for dechlorination at BAT (sintering BAT-3 and BAT-4) was based upon sulfide addition.

Toxic Organic Pollutants and Cyanide

The primary purpose of alkaline chlorination is to oxidize cyanide, phenols, and other toxic organic pollutants found in sintering wastewaters, although other pollutants, such as ammonia-N, are also oxidized. The capabilities of alkaline chlorination were established primarily on the basis of pilot study and full-scale operating data from ironmaking operations. Refer to the ironmaking report for a more detailed review of these data. Although the cyanide and phenols levels of sintering process wastewaters are slightly different than those of the ironmaking wastewaters noted above, the data demonstrate the ability of this technology to achieve similar levels of treatment while processing wastewaters of varying quality. The capabilities of this technology, with respect to cyanide and phenols treatment, are more closely related to design criteria than to the nature of the process (i.e., the basic reactions). The pH adjustment and dechlorination steps have been positioned in the model treatment systems to provide sufficient reaction time such that complete cyanide destruction can be achieved.

The treatment capabilities of activated carbon treatment technology were developed on the basis of pilot studies, sampling data from a full-scale operation, and literature predicting treatment performance. The capabilities of this technology with regard to each toxic organic pollutant are reflected in the changes indicated on the BAT cost tables in Section VIII. Refer to Volume I and the ironmaking report for a detailed review of the data and the procedures used to determine the various effluent levels. As noted previously, phenols will serve as an indicator of the presence and control of the various toxic organic pollutants.

Residual Chlorine

A total residual chlorine limitation of 0.5 mg/l maximum is included in BAT Alternative Nos. 3 and 4 to control excess chlorine resulting from alkaline chlorination. Various reducing compounds can be employed to destroy excess chlorine. The chemistry of this reaction is well documentated throughout the literature and the technology is well demonstrated in other industries.

Effluent Limitations for the BAT Alternatives

The effluent limitations associated with the BAT treatment alternatives were developed on a mass basis (kg/kkg or lb/1000 lb) by applying the model plant effluent flow of 75 gal/ton to the respective BAT treated effluent concentrations of each pollutant. The effluent limitations for each alternative were established using the procedures outlined in Volume I. The effluent flow and concentrations have been previously documented in this section. Table X-1 presents the effluent loadings developed for each treatment alternative.

Selection of a BAT Alternative

The Agency selected BAT Alternative No. 3 as the BAT model treatment system. Before selecting Alternative No. 3 the Agency reviewed the toxicity of each pollutant considered for limitation at BAT, the effluent levels of these pollutants in each treatment alternative, and other environmental factors. On the basis of these considerations, the Agency determined that BAT Alternative No. 3 provides the most significant benefits with regard to reductions in toxic pollutant effluent loads. Since chlorinated organics have not been found to any substantial degree and are not predicted to be formed by alkaline chlorination of sintering wastewaters, and brominated compounds are introduced only at low levels, the activated carbon step of BAT No. 4 is not considered necessary. The Agency concludes that the effluent load reduction benefits associated with alkaline chlorination of sintering wastewaters outweigh the negative aspects of the possible generation of low levels of brominated compounds.

The proposed BAT effluent limitations are presented on Table X-1. As noted in Volume I, the effluent limitations for central treatment systems will be equal to the sums of the limitations for each pollutant in each subcategory. Referring to the central treatment discussion in Section VII, it must be recognized that many plants will co-treat sintering and ironmaking process wastewaters. In the interest of establishing compatible effluent limitations for the sintering and ironmaking subcategories, the Agency is proposing ammonia-N limitations for the sintering subcategory based upon the concentration value developed for the selected ironmaking BAT alternative (similar to sintering BAT No.3) and the sintering model BAT effluent flow.

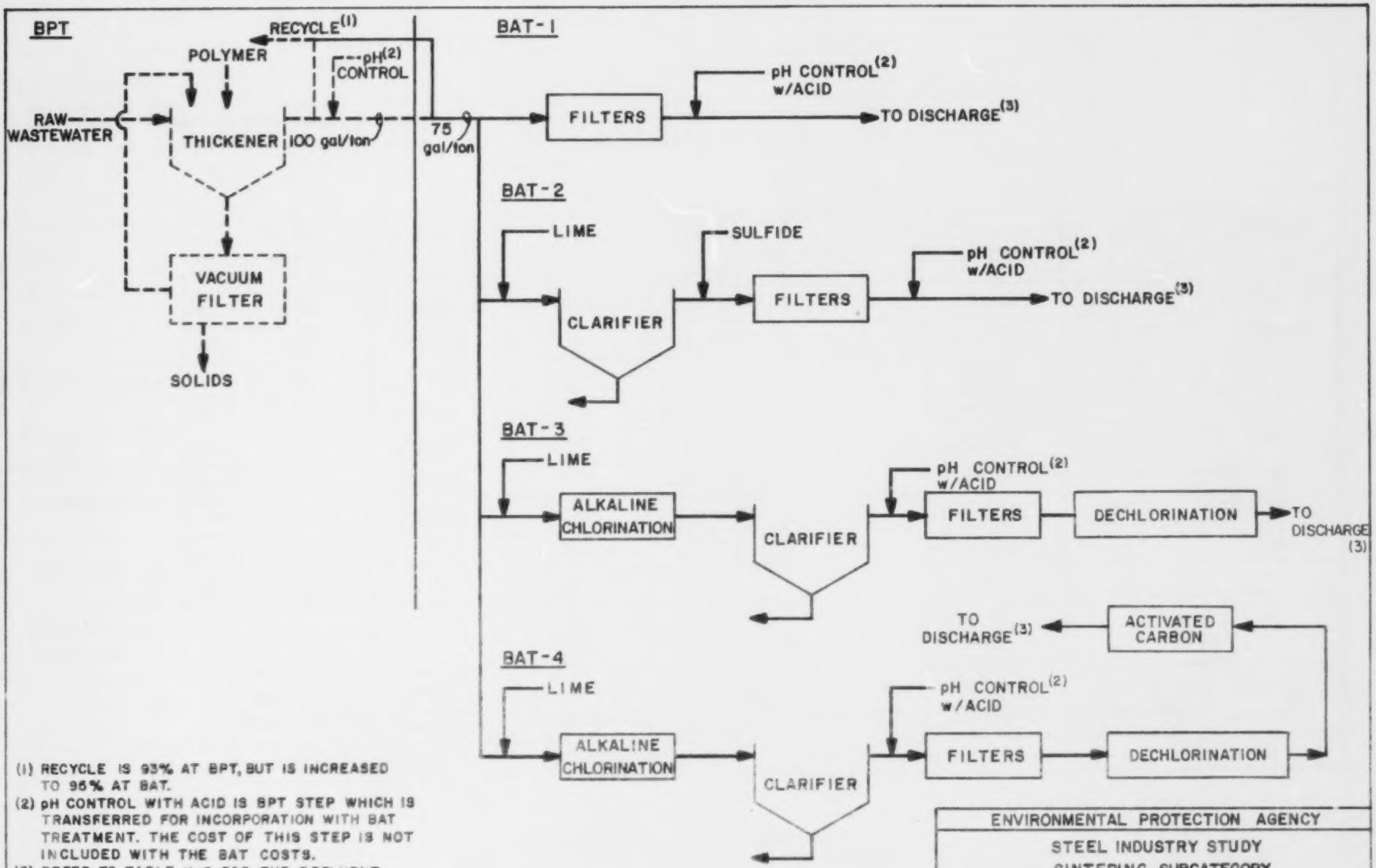
TABLE X-1
BAT EFFLUENT LEVELS AND LOADS
SINTERING SUBCATEGORY

		BAT ALTERNATIVE 1		BAT ALTERNATIVE 2		BAT ALTERNATIVE 3		BAT ALTERNATIVE 4	
		CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)
DISCHARGE FLOW(gal/ton)		75	———	75	———	75	———	75	———
AMMONIA(as N)[1]	Ave.	NA	NA	NA	NA	1.0	0.00031	NA	NA
	Max.	NA	NA	NA	NA	2.0	0.00063	NA	NA
CYANIDE(Total)	Ave.	0.5	0.00016	0.5	0.00016	0.25	0.000078	0.25	0.000078
	Max.	1.0	0.00031	1.0	0.00031	0.50	0.00016	0.50	0.00016
PHENOLS(4 AAP)	Ave.	2.0	0.00063	2.0	0.00063	0.10	0.000031	0.05	0.000016
	Max.	4.0	0.0013	4.0	0.0013	0.20	0.000063	0.10	0.000031
CHLORINE(Residual)	Max.	NA	NA	NA	NA	0.5	0.00016	0.5	0.00016
LEAD	Ave.	0.10	0.000031	0.10	0.000031	0.10	0.000031	0.10	0.000031
	Max.	0.30	0.000094	0.30	0.000094	0.30	0.000094	0.30	0.000094
ZINC	Ave.	0.10	0.000031	0.10	0.000031	0.10	0.000031	0.10	0.000031
	Max.	0.30	0.000094	0.30	0.000094	0.30	0.000094	0.30	0.000094

Proposed BAT Effluent Limitations Guidelines are based on the selected alternative, BAT Alternative No. 3.

(1): The proposed ammonia effluent limitations was developed for the selected alternative only. Refer to Section X for additional details.

NA: Not Applicable.


BPT
RAW WASTEWATER
POLYMER
RECYCLE(1)
pH(2) CONTROL
THICKENER
100 gal/ton
VACUUM FILTER
SOLIDS
75 gal/ton
BAT-1
FILTERS
pH CONTROL(2) w/ACID
TO DISCHARGE(3)
BAT-2
LIME
CLARIFIER
SULFIDE
FILTERS
pH CONTROL(2) w/ACID
TO DISCHARGE(3)
BAT-3
LIME
ALKALINE CHLORINATION
CLARIFIER
pH CONTROL(2) w/ACID
FILTERS
DECHLORINATION
TO DISCHARGE (3)
BAT-4
LIME
ALKALINE CHLORINATION
CLARIFIER
pH CONTROL(2) w/ACID
FILTERS
DECHLORINATION
ACTIVATED CARBON
TO DISCHARGE(3)

(1) RECYCLE IS 93% AT BPT, BUT IS INCREASED TO 95% AT BAT.

(2) pH CONTROL WITH ACID IS BPT STEP WHICH IS TRANSFERRED FOR INCORPORATION WITH BAT TREATMENT. THE COST OF THIS STEP IS NOT INCLUDED WITH THE BAT COSTS.

(3) REFER TO TABLE X-3 FOR THE EFFLUENT QUALITY ASSOCATED WITH EACH TREATMENT ALTERNATIVE.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
BAT TREATMENT ALTERNATIVES

Dwn.5/7/80

FIGURE X-1

SINTERING SUBCATEGORY

SECTION XI

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

Introduction

The 1977 Amendments added Section 301(b)(4)(E) to the Act, establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 308(b)(4) - BOD, TSS, fecal coliform and pH - and any additional pollutants defined by the Administrator as "conventional." On July 28, 1978, EPA proposed that COD, oil and grease, and phosphorus be added to the conventional pollutant list (43 Fed. Reg. 32857). Only oil and grease was added.

BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. BCT requires that limitations for conventional pollutants be assessed in light of a new "cost-reasonableness" test, which involves a comparison of the cost and level of reduction of conventional pollutants from the discharge of POTWs to the cost and level of reduction of such pollutants from a class or category of industrial sources. As part of its review of BAT for certain "secondary" industries, EPA proposed methodology for this cost test. (See 43 Fed. Reg. 37570, August 23, 1978).

Development of BCT Limitations

The Agency developed effluent levels of 15 mg/l for suspended solids and of 10 mg/l (maximum) for oils and greases in the various treatment models based upon a statistical review of long-term analytical data for several wastewater filtration operations. The particulate matter and oils and greases present in sintering process wastewaters exhibit behavior basically similar to that of the solids and oils and greases in other wastewaters where filtration technologies are employed. In this subcategory, and in the reference subcategories, the suspended solids are principally discrete particles (primarily iron oxides) and the oils and greases are basically free (i.e., not soluble). The capabilities of filtration systems, relative to the treatment of sintering wastewaters, are thus more closely related to proper system design (i.e., media selection, filter bed sizing, backwash capacity) than to the basic nature of the process. Refer to Appendix A of Volume I for a detailed review of the thirty-day average and daily maximum suspended solids and oil and grease effluent concentrations.

The Agency developed two BCT alternative treatment systems which are compatible with the BAT alternative treatment systems. The first BCT alternative system includes filtration of the BPT effluent, and the second includes both clarification and filtration of the BPT effluent. As noted in Section X, these treatment components are included in the model BAT treatment system for toxic pollutant removal.

Following are the conventional pollutant treatment costs for each BCT alternative:

	Conventional Pollutant Treatment Costs
BCT-1 (BAT-1)	$0.81/lb
BCT-2 (BAT-2,3,4)	$1.36/lb

As the treatment costs for BCT Alternative No. 1 are less than the reference POTW conventional pollutant treatment cost of $1.34/lb, this treatment alternative passes the BCT cost test. Hence, BCT effluent limitations, based upon filtration are proposed.

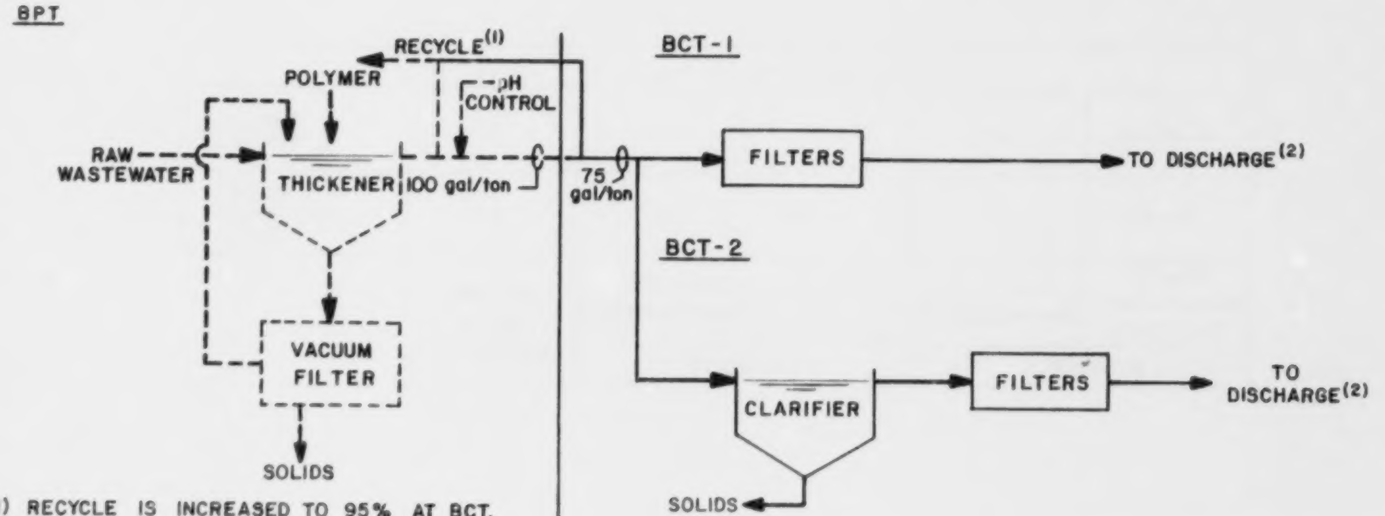
BCT Effluent Limitations
Guidelines, Treatment Scheme, and Costs

Because BCT pertains to the removal of conventional pollutants, the proposed BCT effluent limitations consider only suspended solids, oil and grease, and pH. Since both BCT alternatives provide the same effluent quality, BCT Alternative No. 1 was selected as the basis of the proposed BCT effluent limitations for the sintering subcategory. Reference is made to Table XI-1.

TABLE XI-1
BCT EFFLUENT LEVELS AND LOADS
SINTERING SUBCATEGORY

	DISCHARGE FLOW gal/ton	AVERAGE		MAXIMUM	
		CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)
TOTAL SUSPENDED SOLIDS	75	15	0.0047	40	0.0125
OIL AND GREASE (1)	75	—	—	10	0.00313
pH	75	Within the range 6.0 to 9.0			

(1) Effluent limitations for oils and greases have been provided in recognition of the co-treatment options available to those plants with sintering and ironmaking operations. Refer to Section XI for details.


BPT
RECYCLE(1)
POLYMER
pH CONTROL
RAW WASTEWATER
THICKENER
100 gal/ton
VACUUM FILTER
SOLIDS
75 gal/ton
BCT-1
FILTERS
TO DISCHARGE(2)
BCT-2
CLARIFIER
SOLIDS
FILTERS
TO DISCHARGE(2)

(1) RECYCLE IS INCREASED TO 95% AT BCT.

(2) REFER TO TABLE XI-1 FOR THE EFFLUENT QUALITY ASSOCATED WITH EACH TREATMENT ALTERNATIVE.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
BCT TREATMENT ALTERNATIVES

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FIGURE XI-1

SINTERING SUBCATEGORY

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS

Introduction

A new source is defined as any source constructed after new source performance standards (NSPS) are proposed. NSPS are to be established based upon a consideration of the degree of effluent reduction achievable through the application of the Best Available Demonstrated Control Technology (BADCT), processes, operating methods, or other alternatives including, where practicable, a standard permitting no discharge of process wastewater pollutants to navigable waters. The Agency concluded that zero discharge, however, is not a feasible treatment alternative for "wet" sintering operations. As discussed in Section VII, there are no technologies applicable to all operations in this subcategory which would enable them to attain zero discharge of process wastewater pollutants in a cost effective manner. It must be noted that new source sintering operations may choose to employ "dry" operations, with the result that no process wastewaters would be generated. While this would represent a zero discharge system, it must also be noted that a new source sintering operation may choose to use a "wet" system. NSPS alternative treatment systems and effluent standards have been developed to accommodate the latter case.

Identification and Basis for NSPS Treatment Scheme and Flow Rates

NSPS Alternative No. 1

This alternative is identical to BPT and BAT Alternative No. 1 (refer to Section X). This system provides for the sedimentation of raw process wastewaters in a thickener. A flocculant is added to enhance solids removal. Treatment process sludges are dewatered by vacuum filtration. Most of the thickener effluent (95%) is recycled to the process, while the remaining thickener effluent is discharged as a blowdown. The recycle blowdown undergoes filtration to remove toxic metals and suspended solids. Prior to discharge, the pH of the treated effluent is adjusted (as necessary) to the neutral range with acid.

NSPS Alternative No. 2

This alternative is identical to BPT and BAT Alternative No. 2. In addition to the treatment components noted above for the first NSPS alternative, lime addition (for the purpose of metal precipitate formation), sedimentation in a clarifier, and sulfide precipitation, are incorporated prior to the filtration component.

NSPS Alternative No. 3

This alternative is identical to BPT and BAT Alternative No. 3. In addition to the treatment technologies of the previous alternative, alkaline chlorination (prior to the clarification component) is incorporated in this alternative for the purposes of cyanide and phenols oxidation. Dechlorination is provided prior to discharge.

NSPS Alternative No.4

This alternative is identical to BPT and BAT Alternative No. 4. This alternative provides for the removal, by activated carbon adsorption, of the remaining toxic organic pollutants that may be present.

In order to accommodate process developments which would be incorporated in the construction of a new source "wet" sintering operation, the Agency examined various industry trends. In all likelihood, new sintering operations will have greater production capacities than the 4000 tons/day used for BPT and BAT model treatment systems. The Agency averaged the production capacities of sintering operations constructed in the last decade and, based on that average, established a new source model size of 7,000 tons/day, which used for NSPS costing. Although the effluent limitations (lb/1000 lb) developed for the BAT model treatment systems are the same as those for the new source systems, the increased model size for new source operations results in increased treatment model capital and annual expenditures due to the increase in the volume of wastewater requiring treatment. A review of the subcategory summary data indicate that the model BPT and BAT applied and discharge flows are applicable to new "wet" sintering operations. Trends which impact flow were not detected.

The NSPS treatment systems described above are depicted in Figure XII-1. The corresponding effluent levels and loads are presented in Table XII-1. Cost data for the NSPS treatment alternatives are presented in Section VIII.

Rationale for Selection of NSPS

The NSPS alternative treatment systems use the same treatment system components described for the BPT, BAT, and BCT model treatment systems discussed in Sections IX, X, and XI. Reference is made to those sections for a review of the treatment technology.

Selection of an NSPS Alternative

The Agency selected NSPS Alternative No. 3 as the NSPS model treatment system. This alternative was selected for the same reasons noted in Section X regarding the selection of the BAT model treatment system (i.e., the benefits derived from reduction in the effluent loads of various pollutants).

The proposed NSPS are presented on Table XII-1. As noted in Section X, a proposed ammonia-N effluent standard is provided to establish compatibility with the ironmaking limitations and standards.

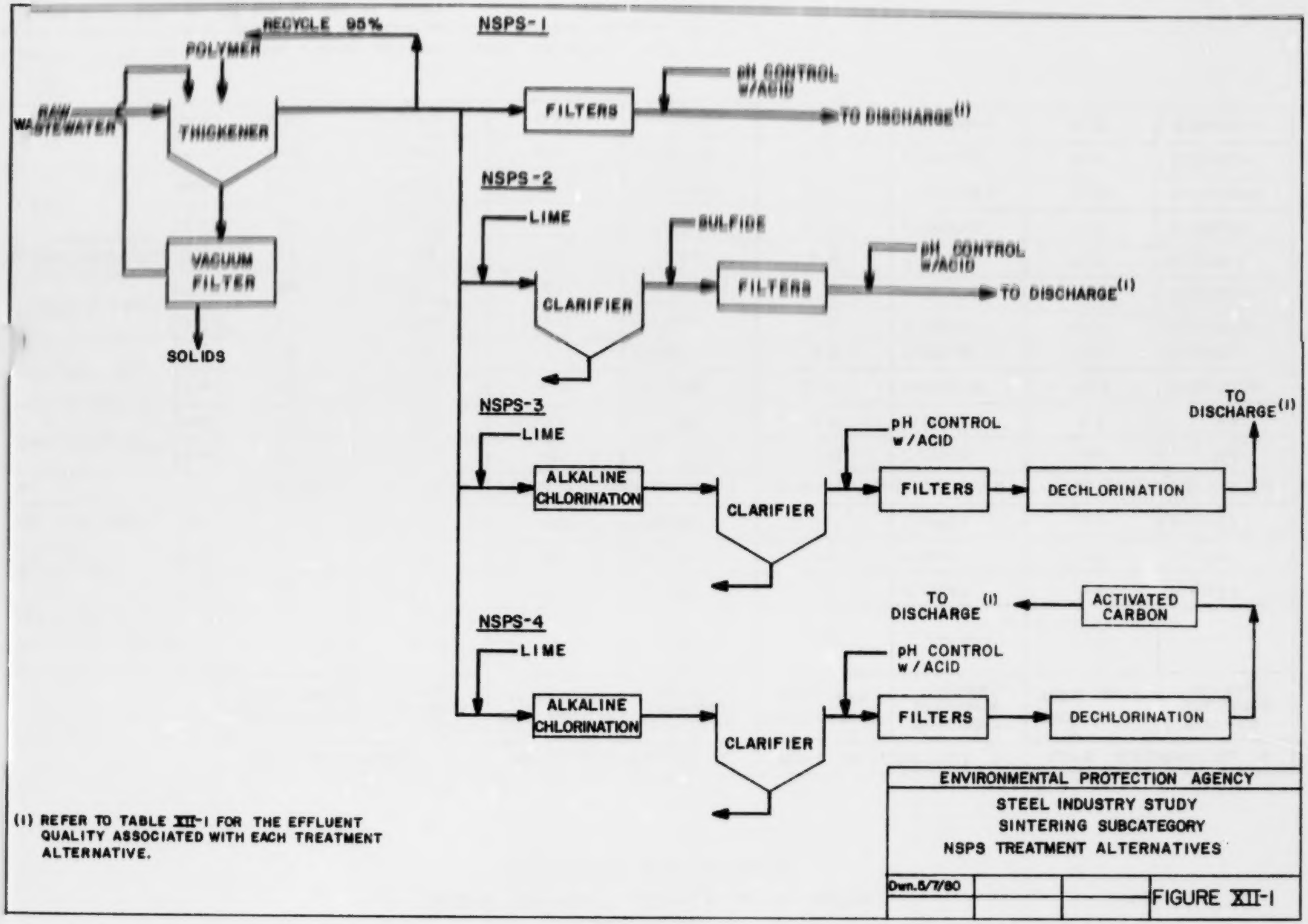
TABLE XII-1
NSPS EFFLUENT LEVELS AND LOADS
SINTERING SUBCATEGORY

		NSPS ALTERNATIVE 1		NSPS ALTERNATIVE 2		NSPS ALTERNATIVE 3		NSPS ALTERNATIVE 4	
		CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)
DISCHARGE FLOW (gal/ton)		75	———	75	———	75	———	75	———
TOTAL SUSPENDED SOLIDS	Ave.	15	0.0047	15	0.0047	15	0.0047	15	0.0047
	Max.	40	0.0125	40	0.0125	40	0.0125	40	0.0125
OIL AND GREASE	Max.	10	0.0031	10	0.0031	10	0.0031	10	0.0031
PH		Within the range 6.0 to 9.0		Within the range 6.0 to 9.0		Within the range 6.0 to 9.0*		Within the range 6.0 to 9.0	
AMMONIA(as N)(1)	Ave.	NA	NA	NA	NA	1.0	0.00031	NA	NA
	Max.	NA	NA	NA	NA	2.0	0.00063	NA	NA
CYANIDE(Total)	Ave.	0.5	0.00016	0.5	0.00016	0.25	0.000078	0.25	0.000078
	Max.	1.0	0.00031	1.0	0.00031	0.5	0.00016	0.5	0.00016
PHENOLS(4 AAP)	Ave.	2.0	0.00063	2.0	0.00063	0.10	0.000031	0.05	0.000016
	Max.	4.0	0.0013	4.0	0.0013	0.20	0.000063	0.10	0.000031
CHLORINE (RESIDUAL)	Max.	NA	NA	NA	NA	0.5	0.00016	0.5	0.00016
LEAD	Ave.	0.10	0.000031	0.10	0.000031	0.10	0.000031	0.10	0.000031
	Max.	0.30	0.000094	0.30	0.000094	0.30	0.000094	0.30	0.000094
ZINC	Ave.	0.10	0.000031	0.10	0.000031	0.10	0.000031	0.10	0.000031
	Max.	0.30	0.000094	0.30	0.000094	0.30	0.000094	0.30	0.000094

Proposed NSPS are based on the selected alternative, NSPS Alternative No.3.

(1): The proposed ammonia effluent standard was developed for the selected alternative only. Refer to Sections X and XII for further details.

NA: Not Applicable.


RAW WASTEWATER
POLYMER
RECYCLE 95%
THICKENER
VACUUM FILTER
SOLIDS
NSPS-1
FILTERS
pH CONTROL W/ACID
TO DISCHARGE(1)
NSPS-2
LIME
CLARIFIER
SULFIDE
FILTERS
pH CONTROL W/ACID
TO DISCHARGE(1)
NSPS-3
LIME
ALKALINE CHLORINATION
CLARIFIER
pH CONTROL w/ACID
FILTERS
DECHLORINATION
TO DISCHARGE(1)
NSPS-4
LIME
ALKALINE CHLORINATION
CLARIFIER
pH CONTROL w/ACID
FILTERS
DECHLORINATION
ACTIVATED CARBON
TO DISCHARGE(1)
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(1) REFER TO TABLE XIII-1 FOR THE EFFLUENT QUALITY ASSOCIATED WITH EACH TREATMENT ALTERNATIVE.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
NSPS TREATMENT ALTERNATIVES

FIGURE XIII-1

SINTERING SUBCATEGORY

SECTION XIII

PRETREATMENT STANDARDS FOR DISCHARGES TO PUBLICLY OWNED TREATMENT WORKS

Introduction

This section discusses the control and treatment alternatives available for sintering operations which discharge wastewaters to publicly owned treatment works (POTWs). Two sintering plants currently discharge process wastewaters to POTWs. Separate consideration has been given to the pretreatment of sintering wastewaters for new sources (PSNS) and existing sources (PSES).

The general pretreatment and categorical pretreatment standards applying to sintering operations are discussed below.

General Pretreatment Standards

For detailed information on Pretreatment Standards refer to 43 FR 27736-2777, "General Pretreatment Regulations for Existing and New Sources of Pollution," (June 26, 1978). In particular, 40 CFR Part 403 describes national standards (prohibited and categorical standards), revision of categorical standards through removal allowances, and POTW pretreatment programs.

In establishing pretreatment standards for sintering operations, the Agency gave primary consideration to the objectives and requirements of the General Pretreatment Regulations. The General Pretreatment Regulations set forth general discharge prohibitions that apply to all non-domestic users of a POTW to prevent pass-through of pollutants, interference with the operation of a POTW, and municipal sludge contamination. The regulations also establish administrative mechanisms to ensure application and enforcement of prohibited discharge limits and categorical pretreatment standards. In addition, the Regulations contain provisions relating directly to the determination of and reporting on Pretreatment Standards.

POTWs are usually not designed to treat the toxic pollutants present in sintering process wastewaters. Instead, POTWs are designed to treat biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform bacteria, and pH. Whatever removal is obtained by POTWs for toxic pollutants is incidental to the POTWs main function of conventional pollutant treatment. POTWs have, historically, accepted large amounts of many pollutants well above their capacity to treat them adequately. As the issue of municipal sludge use has become more important, pretreatment standards must address toxic and nonconventional pollutant removal, rather than transfer these pollutants to POTWs where many pollutants concentrate in the sludges.

Pretreatment standards for total suspended solids, oil and grease, and pH are not proposed because these pollutants, at the levels found after pretreatment in this subcategory, are compatible with POTW operations and can be effectiely treated at POTWs.

Due to the presence of toxic pollutants in wastewaters from sintering operations, pretreatment must be provided to ensure that these pollutants do not interfere with, pass through, or otherwise be incompatible with POTW operations or damage the treatment facilities. The following discussions identify the pretreatment alternatives considered for toxic pollutant removal, the rationale for these technologies, and, finally, the selection of a pretreatment alternative upon which the proposed categorical PSES and PSNS are based.

Identification of Pretreatment Alternatives

PSES and PSNS alternative treatment systems are identical to NSPS Alternative Nos. 1, 2, and 3, (refer to Sections X and XII for a discussion of these treatment systems). A summary of the treatment components incorporated in each pretreatment alternative system follows:

PSES and PSNS No. 1 - Flocculant addition, gravity sedimentation in a thickener, vacuum filtration of sludges, recycle (95%), filtration of the system blowdown and neutralization (with acid) of the system effluent.

PSES and PSNS No. 2 - In addition to the components noted above, lime addition, clarification, and sulfide precipitation are incorporated prior to filtration.

PSES and PSNS No. 3 - Alkaline chlorination is incorporated prior to clarification. The pH of the clarifier effluent is neutralized with acid prior to filtration. The filter effluent is dechlorinated.

In developing the alternative pretreatment systems, the Agency evaluated the treatment components and alternative systems incorporated in BAT and NSPS.

The major goal of pretreatment is to provide reductions in the effluent levels of cyanide and the toxic inorganic and organic pollutants. Filtration and sulfide precipitation are incorporated for the purpose of reducing toxic metals effluent levels. As noted in Section X, most of the toxic metals waste load is entrained in the particulate matter suspended in the process wastewaters. Consequently, suspended solids control by sedimentation and filtration results in the removal of a substantial portion of the toxic metals load. Lime precipitation will ensure reductions in toxic metals levels and loads, as this technology can effectively precipitate that portion of the toxic metals load which may be dissolved in the process wastewaters. Alkaline chlorination technology is incorporated as a means of achieving reductions in cyanide and phenols effluent levels.

Figure XIII-1 illustrates the three pretreatment alternative treatment systems described above. Table XIII-1 presents the effluent levels achieved by each alternative for those pollutants considered for limitation. The model pretreatment costs are presented in Section VIII. No effluent standards are proposed for suspended solids and oil and grease as these are conventional pollutants which are compatible with POTW operations. However, suspended solids removal is an important factor in toxic metals control.

Rationale for the Selection of Pretreatment Technologies

The recycle rate incorporated in the pretreatment systems was justified in Section X. Recycle is needed in sintering pretreatment systems in order to minimize the hydraulic impact of process wastewater discharges to a POTW. Excessive flows to a POTW must be restricted not only for reasons of physical limitations (i.e., hydraulics), but also for reasons of process limitations ("washing out" the biological treatment media). The model pretreatment effluent flow of 75 gal/ton is identical to that of the BAT and NSPS models.

As noted previously, the toxic metals present in sintering wastewaters are found primarily in the particulate matter. Therefore, control of suspended solids levels and loads will result in a reduction in the toxic metals effluent levels and loads. Precipitation technologies will ensure optimum toxic metals level and load reductions by providing the capability to remove the toxic metals which may be dissolved in the process wastewaters. Toxic metals found in sintering wastewaters, particularly lead and zinc, can interfere with POTW operations.[3] Other studies[4] have shown that from 50 to 90% of the toxic metals entering a POTW will pass through the system. Therefore, the possibility exists that a POTW could discharge undesireable levels of toxic metals when accepting industrial process wastewaters. Since domestic wastewaters do not typically contain objectionable levels or loads of toxic metals, it is necessary that industrial process wastewater contributors to a POTW control toxic metals in indirect discharges.

The toxic metals which do not pass through a POTW, are not destroyed by the biological treatment process. As a result, these pollutants concentrate in the POTW sludges. Sludges which contain high concentrations of toxic metals and which are used as soil supplements, could adversely affect plant growth and contaminate surface and groundwaters.

Alkaline chlorination is incorporated in the sintering pretreatment alternative because of the demonstrated capability of this technology to destroy cyanide. It has been shown[3] that cyanide, when found at the levels possible in sintering wastewaters, can have an inhibitory effect on the POTW treatment process. Consequently, treatment for cyanide will ensure that POTW treatment operations are not adversely affected. It was also found* that cyanide pass-through averaged 70% in the POTWs studied. As with the toxic metals, the possibility exists that a POTW could discharge undersireable levels of cyanide. As domestic wastewaters are not typically contaminated with cyanide, those industries with high cyanide levels in discharges to POTWs should provide pretreatment to reduce the cyanide effluent levels and loads. Cyanide pass through in a POTW could also result in the generation of the highly toxic cyanogen chloride gas. Incomplete oxidation (as opposed to the complete oxidation provided by alkaline chlorination) of the cyanide passed through the POTW could occur in the POTW's chlorination step. As a result of this incomplete oxidation, cyanogen chloride generation could occur. On the basis of the above impacts, treatment for and control of cyanide in industrial wastewater discharges to POTWs is warranted.

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[3] EPA-430/9-76-017a, Construction Grants Program Information; Federal Guidelines, State and Local Pretreatment Programs.

[4] Federal Register; Friday, September 7, 1979; Part IV; EPA Effluent Guidelines and Standards; Electroplating Point Source Category - pp. 52597-52601.

Selection of Pretreatment Alternative

On the basis of the considerations presented above (i.e., treatment for toxic metals and cyanide), PSES and PSNS Alternative No. 3 were selected as the model treatment systems upon which the proposed PSES and PSNS are based. The proposed standards are presented in Table XIII-1. As noted in Section X, a proposed ammonia-N effluent standard is provided for compatibility between the sintering and ironmaking regulations.

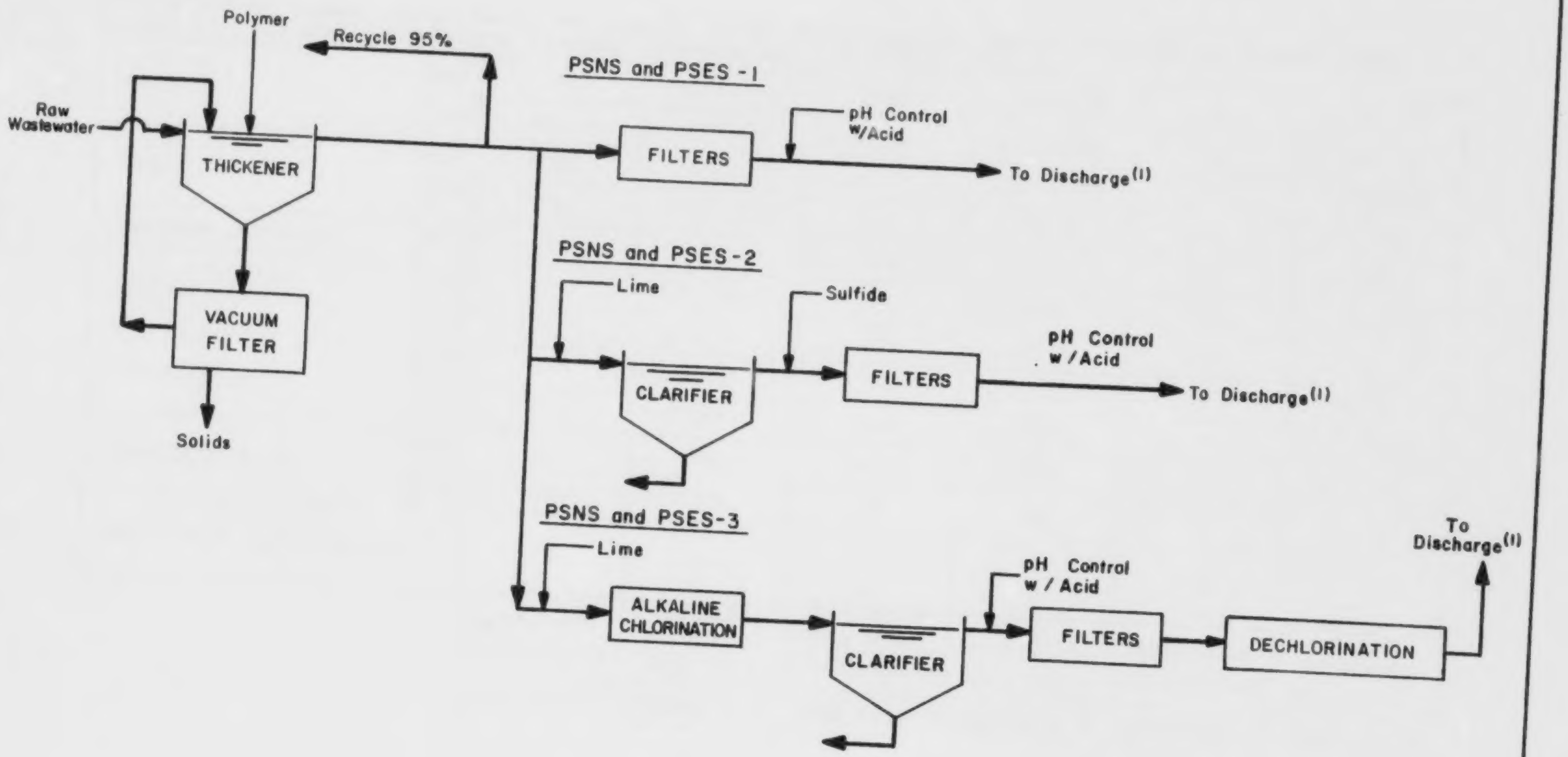
TABLE XIII-1
PSNS and PSES EFFLUENT LEVELS and LOADS
SINTERING SUBCATEGORY

		PSNS/PSES ALTERNATIVE 1		PSNS/PSES ALTERNATIVE 2		PSNS/PSES ALTERNATIVE 3	
		CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)
DISCHARGE FLOW(gal/ton)		75	———	75	———	75	———
AMMONIA(as N)(1)	Ave.	NA	NA	NA	NA	1.0	0.00031
	Max.	NA	NA	NA	NA	2.0	0.00063
CYANIDE(Total)	Ave.	0.5	0.00016	0.5	0.00016	0.25	0.000078
	Max.	1.0	0.00031	1.0	0.00031	0.50	0.00016
PHENOLS (4 AAP)	Ave.	2.0	0.00063	2.0	0.00063	0.10	0.000031
	Max.	4.0	0.0013	4.0	0.0013	0.20	0.000063
CHLORINE (RESIDUAL)	Max.	NA.	NA.	NA.	NA.	0.5	0.00016
LEAD	Ave.	0.10	0.000031	0.10	0.000031	0.10	0.000031
	Max.	0.30	0.000094	0.30	0.000094	0.30	0.000094
ZINC	Ave.	0.10	0.000031	0.10	0.000031	0.10	0.000031
	Max.	0.30	0.000094	0.30	0.000094	0.30	0.000094

Proposed PSES and PSNS are based upon PSNS/PSES Alternative No. 3, the selected alternative.

(1): The proposed ammonia effluent standard was developed for the selected alternative. Refer to Section XIII for additional details.

NA: Not Applicable


Raw Wastewater
Polymer
THICKENER
VACUUM FILTER
Solids
Recycle 95%
PSNS and PSES - 1
FILTERS
pH Control w/Acid
To Discharge(1)
PSNS and PSES - 2
Lime
CLARIFIER
Sulfide
FILTERS
pH Control w / Acid
To Discharge(1)
PSNS and PSES - 3
Lime
ALKALINE CHLORINATION
CLARIFIER
pH Control w / Acid
FILTERS
DECHLORINATION
To Discharge(1)

(1)- Refer to Table XIII - 1 for the effluent quality associated with each treatment alternative.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
PSNS AND PSES TREATMENT ALTERNATIVES

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FIGURE XIII-1

IRONMAKING SUBCATEGORY

SECTION I

PREFACE

The USEPA is proposing effluent limitations guidelines and standards for the steel industry. The proposed regulation contains effluent limitations for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT) as well as pretreatment standards for existing and new sources (PSES and PSNS) and new source performance standards (NSPS), pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act.

This part of the Development Document highlights the technical aspects of EPA's study of the Ironmaking Subcategory of the Iron and Steel Industry. Volume I of the Development Document discusses issues pertaining to the industry in general, while other volumes relate to the remaining subcategories of the industry.

IRONMAKING SUBCATEGORY

SECTION II

CONCLUSIONS

Based upon this current study and a review of previous studies, the Agency has reached the following conclusions:

1. The Agency recognizes the differences between iron and ferromanganese blast furnace operations and their respective wastewaters. However, there are no ferromanganese blast furnaces currently in operation, and none are projected for operation. Separate effluent limitations for ferromanganese blast furnaces are proposed at the BPT level of treatment. At this time, the Agency is not proposing BAT or BCT limitations, or NSPS, PSES, or PSNS for ferromanganese blast furnaces, but believes those limitations and standards should be established on a case-by-case basis in the event the need arises.

2. On the basis of data collected for this study, the BPT effluent limitations originally promulgated in 1974 for iron and ferromanganese blast furnaces are practicable and achievable. The Agency is proposing BPT limitations which are identical to those previously promulgated.

3. The Agency's monitoring of iron making blast furnace process wastewaters revealed significant concentrations of ten toxic inorganic and eight toxic organic pollutants in addition to the currently limited pollutants. The Agency has concluded that the discharge of these pollutants can be controlled by available, economically achievable technologies. A summary of raw waste loadings, and the discharges resulting from attainment of the proposed BPT, BAT, and BCT limitations for iron making blast furnaces, is presented below.

	Effluent Discharges (Tons/Year)		
	Raw Waste	Proposed BPT	Proposed BAT and BCT
Flow (MGD)	1,037	40.5	22.7
TSS	2,998,300	3,082	517.8
Toxic Metals	41,280	385.9	38.3
Toxic Organics[1]	252	9.9	3.8
Ammonia (as N)	15,780	6,349	34.5
Fluoride	15,780	1,233	345.2
Cyanide, Total	15,780	924.6	34.5
Phenols	3,945	246.6	3.5

[1] Does not include total cyanide or any of the individual phenolic compounds.

4. The Agency's estimates of the costs of compliance with the proposed BPT and BAT limitations for the ironmaking subcategory are presented below for facilities in place as of January 1, 1978.

Costs (Millions of July 1, 1978 Dollars)

	Investment Costs			
	Total	In-Place	Required	Annual Costs
BPT	474.2	351.9	122.3	95.3
BAT	24.9	4.3	20.6	4.9

NOTE: BAT costs are in addition to the BPT costs.
BCT and PSES costs are included in the BPT and BAT costs.

The BAT estimated costs of compliance are based upon the Agency's assumption that some dischargers will choose to evaporate blast furnace wastewaters on slag rather than add the alkaline chlorination treatment system which is selected as the BAT model treatment technology. This is a practical (and less expensive) means of achieving the proposed BAT limitations. However, the Agency recognizes that this process may not be feasible for all plants. In order to determine the cost of compliance with the proposed limitations the Agency estimated that 60 percent of the plants would be able and will choose to evaporate process wastewaters on slag, with the remaining 40 percent discharging their wastewaters into navigable waters or POTWs.

The status of the industry with respect to the installation of BPT facilities has been updated from January 1, 1978 to June 30, 1980, to reflect current subcategory costs. Following are the updated costs of compliance for the ironmaking subcategory.

Costs (Millions of July 1978 Dollars)

	Required Costs	Annual Costs of Operation
BPT	$21.91	$87.44
BAT	$16.06	$ 4.02

5. The BPT and BAT model treatment systems for the ironmaking subcategory include wastewater recycle. Responses from the industry for several plants indicate that they do not experience scaling, fouling, or plugging problems with the recycle components used at those plants. The Agency has concluded that a 70 gal/ton blowdown is achievable and practicable as a component of the BAT model wastewater treatment system.

6. The Agency evaluated the "cost/reasonableness" of controlling the discharge of certain conventional pollutants, including suspended solids. The Agency finds that the control costs for these pollutants based on the BCT model treatment systems are less than those for publicly owned treatment works. Therefore, the Agency

has proposed BCT limitations for TSS and for oil and grease, based upon the BCT model treatment system.

7. The Agency has proposed NSPS for ironmaking operations which are equivalent to the proposed BAT limitations and which are based upon the same model wastewater treatment technologies and systems.

8. EPA is proposing pretreatment standards for new (PSNS) and existing (PSES) sources which limit the quantities of toxic and nonconventional pollutants which can be introduced to POTWs.

9. Although several toxic organic and toxic metal pollutants were found in the raw wastewaters of ironmaking operations, the Agency believes it is not necessary to establish limitations for each toxic pollutant. The Agency believes that adequate control of toxic organic pollutants can be achieved by the control of total cyanide and phenols (4AAP). Likewise, control of lead and zinc will result in comparable control of other toxic metal pollutants.

10. To facilitate less costly central treatment and to make the ironmaking limitations compatible with those for sintering operations, the Agency is proposing an oil and grease effluent limitation for the ironmaking subcategory.

11. With regard to Third Circuit "remand issues," the Agency concludes that:

    a. Its estimated costs for the model wastewater treatment systems are sufficient to cover all costs required to install and operate the model technologies, whether as an initial fit or a retrofit. The Agency has also concluded that the ability to implement the model wastewater treatment systems is not affected by plant age. A comparison between the costs reported by the industry and the EPA's estimated costs for several plants demonstrates the estimated model wastewater treatment costs are sufficient to account for all site-specific and other incidental costs which might be incurred.

    b. The incorporation of recycle through cooling towers at the BPT and BAT levels of treatment and the use of evaporation of process wastewaters on slag as a means of achieving BAT levels of treatment will result in minor increases in water consumption. It is estimated that implementation of the technologies incorporated in the BPT model treatment system will result in a net increase in water consumption of 5.4 MGD. This increase represents 0.5 percent of the total volume of water applied in this subcategory. Implementation of the treatment technologies incorporated in the BAT model treatment system will result in a net increase of 13.9 MGD. This increase represents 1.3 percent of the total volume of water applied in this subcategory. However, recycle also significantly reduces or eliminates the discharge of pollutants. Since the total water consumption is small compared to total industry water usage, the Agency has concluded that the impact of the proposed limitations on the consumptive use of water in this subcategory is minimal and is justified by the effluent reduction benefits resulting from their use. These technologies are in use at plants in "arid" and "semi-arid" regions.

12. Table II-1 presents the treatment model flow and effluent quality data used to develop the proposed BPT effluent limitations for the ironmaking subcategory, and Table II-2 presents these proposed limitations. Table II-3 presents the treatment model flow and effluent quality data used to develop the proposed BAT and BCT effluent limitations and the proposed NSPS, PSES, and PSNS for the ironmaking subcategory; Table II-4 presents these proposed limitations and standards.

TABLE II-1

BPT TREATMENT MODEL FLOWS AND EFFLUENT QUALITIES IRONMAKING SUBCATEGORY

Type of Ironmaking Operation		Pollutant	Monthly Average Concentration (mg/l)(1)
Iron Making		Flow, gal/ton	125
		TSS	50
		Ammonia (N)	103
	121	Total Cyanide	15
		Phenolics (4AAP)	4
		pH, Units	6.0-9.0
Ferromanganese		Flow, gal/ton	250
		TSS	100
		Ammonia (N)	411
	121	Total Cyanide	150
		Phenolics (4AAP)	20
		pH, Units	6.0-9.0

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(1) Daily maximum concentrations are three times the above monthly average concentrations.

TABLE II-2

PROPOSED BPT EFFLUENT LIMITATIONS
IRONMAKING SUBCATEGORY

Type of Ironmaking Operation		Pollutant	Effluent Limitations[1] (kg/kkg of Product)
Iron Making		TSS	0.0260
		Ammonia (N)	0.0535
	121	Total Cyanide	0.0078
		Phenolics (4AAP)	0.0021
		pH, Units	Within the range 6.0-9.0
Ferromanganese		TSS	0.1043
		Ammonia (N)	0.4287
	121	Total Cyanide	0.1563
		Phenolics (4AAP)	0.0208
		pH, Units	Within the range 6.0-9.0

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(1) Daily maximum effluent limitations are three times the above monthly average effluent limitations.

TABLE II-3

TREATMENT MODEL FLOW AND EFFLUENT QUALITY
IRONMAKING SUBCATEGORY

Pollutant	BAT	BCT	NSPS	PSES	PSNS
	Monthly Average Concentration (mg/l)(1)				
Flow, gal/ton	70	70	70	70	70
TSS	-	15	15	-	-
Oil and Grease	-	10*	10*	-	-
Ammonia (N)	1.0	-	1.0	1.0	1.0
121 Total Cyanide	1.0	-	[illegible]	[illegible]	[illegible]
Phenolics (4AAP)	0.10	-	[illegible]	[illegible]	[illegible]
TRC	[illegible]	-	[illegible]	[illegible]	[illegible]
122 Lead	0.25	-	[illegible]	[illegible]	[illegible]
128 Zinc	0.30	-	[illegible]	[illegible]	[illegible]
pH, Units	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTE: The above values apply to both iron making and ferromanganese furnace operations.

(1) Daily maximum concentrations are the above monthly average concentrations multiplied by the following factors:

Pollutant(s)	Factor
TSS	[illegible]
Ammonia (N), Total Cyanide, Phenolics (4AAP)	[illegible]
Lead, Zinc	[illegible]

*: As shown, daily maximum concentration only.

TABLE [illegible]

PROPOSED EFFLUENT LIMITATIONS AND STANDARDS
IRONMAKING SUBCATEGORY

Pollutant		Effluent Limitations and Standards (kg/kkg of Product)(1)				
		BAT	BCT	NSPS	PSES	PSNS
	TSS	—	.438	[illegible]	—	—
	Oil and Grease	—	.292*	[illegible]	—	—
	Ammonia (N)	20.2	—	[illegible]	20.2	14.6
121	Total Cyanide	20.2	—	[illegible]	20.2	14.6
	Phenolics (4AAP)	2.92	—	[illegible]	2.92	2.92
	TRC	16.64*	—	[illegible]	16.64	14.6*
122	Lead	7.30	—	[illegible]	7.30	7.30
128	Zinc	8.76	—	[illegible]	8.76	8.76
	pH, Units	—	Within the range 6.0 to 9.0	Within the range 6.0 to 9.0	—	—

NOTE: The above values apply to both iron making and ferromanganese furnace operations.

(1) The proposed limitations and standards have been multiplied by 10^5 to obtain the values presented in this table. Daily maximum limitations and standards are the above monthly average limitations and standards multiplied by the following factors:

Pollutant(s)	Factor
TSS	2.67
Ammonia (N), Total Cyanide, Phenolics (4AAP)	3.00
Lead, Zinc	3.00

*: As shown, daily maximum limitations and standards only.

IRONMAKING SUBCATEGORY

SECTION III

INTRODUCTION

General Discussion

The production of steel involves three basic stages. First, coal is converted to coke. Second, coke is combined with iron bearing material and limestone and reduced in a blast furnace to form molten iron. Third, the iron is purified into steel in an open hearth, basic oxygen or electric arc furnace.

Process wastewaters are generated in ironmaking operations as a result of gas cleaning and cooling which permits the reuse of the gas as a fuel. For the purpose of this study, the ironmaking subcategory encompasses the operation of two types of blast furnaces: iron and ferromanganese.

The Agency previously promulgated a regulation governing blast furnace operations in 1974 and established limitations for the following pollutants:

Ammonia (N)
Cyanide (Total)
Phenolics
Fluoride
Sulfide
Total Suspended Solids
pH

Data Collection Activities

Industry responses to the basic questionnaires (DCPs) comprise the major source of data for blast furnace operations. The Agency requested information pertaining to production, processes, process water usage, process wastewater discharge, and wastewater treatment systems. The DCP responses for iron blast furnaces are summarized and tabulated in Table III-1. The DCP information for the ferromanganese blast furnace is summarized and tabulated in Table III-2.

The Agency sent detailed questionnaires (D-DCPs) to selected plants to gather cost and furnace operating data and long-term analytical data. The responses to these questionnaires provided useful data which verified cost estimates, established retrofit costs (if any), and provided additional effluent quality data. The Agency identified 56 plants with blast furnace operations. One firm claimed confidentiality with respect to all data submitted and collected during surveys, and these data do not appear in Table III-1. The Agency also identified one ferromanganese blast furnace and 164 iron blast furnaces at the 56 plants with active blast furnace operations. The operation of 4 to 6 furnaces per plant is not uncommon and one plant has 11 active furnaces. Table III-3 summarizes the data base for ironmaking operations.

Description of the Blast Furnace Process

Blast furnaces are large cylindrical structures in which molten iron is produced by the reduction of iron bearing ores with coke and limestone. Reduction is promoted by blowing heated air into the lower part of the furnace. As the raw materials melt and decrease in volume, the entire mass of the furnace charge descends. Additional raw materials are added (charged) at the top of the furnace to keep the raw material mass within the furnace at a constant level.

Iron oxides react with the hot carbon monoxide from the burning coke, and the limestone reacts with impurities in the iron bearing material and the coke to form molten slag. These reactions start at the top of the furnace and proceed to completion as the charge passes to the bottom of the furnace. The molten slag, which floats on top of the molten iron, is drawn off (tapped) by way of a tapping hole. The molten iron is also tapped through a hole below the slag tapping hole.

The production of iron from a blast furnace is based upon the following approximate charge and yield relationships:

Raw Materials	Products
1.8 kkg iron ore	
0.5 kkg coke	1.0 kkg iron
0.45 kkg limestone	0.3 kkg slag
3.3 kkg air	4.5 kkg process gas

Blast furnace operations within the U.S. primarily produce (>99%) basic iron. Several plants have occasionally produced ferromanganese iron, although during this study only one ferromanganese furnace was found (Figure III-4). Production of iron (rated capacity) on a plant basis ranges from 900 to 11,300 TPD (Table III-4). The total rated capacity of all plants was 221,847 TPD (excluding the confidential plant). Twenty-five percent of the plants accounted for 53 percent of the total rated capacity in the U.S.

The gases which are produced in the furnace are exhausted through the top of the furnace. These gases are cleaned, cooled, and then burned to preheat the incoming air to the furnace. Generally, gas cleaning involves the removal of the larger particulates by a dry dust collector, followed by a variety of "wet" or "wet/dry" gas cleaning systems for fine particulate removal. The three most common gas cleaning systems are illustrated in Figures III-1, 2, and 3. The first system (Type I) uses one wet scrubber (primary); the second (Type II) uses two wet scrubbers (primary and secondary); and the third (Type III) uses one wet scrubber and one dry air pollution control device. Gases are cooled with direct contact sprays in large gas cooling vessels. At many plants, all or a portion of the gas cooling wastewaters are cascaded to the gas cleaning systems described above.

Description of Wastewater Treatment

Prior to the mid 1970's, the treatment of ironmaking wastewaters generally included the removal of solids by sedimentation with the addition of flocculating agents to improve removal efficiencies. The clarified wastewaters were typically discharged directly on a once-through basis without further treatment. Today, however, about ninety percent of the blast furnace wastewater treatment systems include recycle (after the thickener), and discharge only a relatively small percentage (generally 5 to 10%) of the process flow. Nearly all recycle systems employ cooling towers to reduce recycle wastewater temperatures. The thickener underflows are typically dewatered by vacuum filters with the filtrate returned to the thickener influent. The dewatered solids are either sent to sintering operations or to off-site disposal. The specific treatment practices in use at each of the 54 plants are detailed in Table III-1. Similar data are presented in Table III-2 for the ferromanganese furnace.

TABLE III-1

GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components		Operating Mode	Discharge Mode
							Process Treatment	Central Treatment		
0060	1953		4730	3598	2001	140	CT, T	NW, SL(Unk), FLL, FLP, FLO(1) CL, SS	RTP 90	Direct
						40(Misc.Drains)	UNTREATED		OT	Direct
0060A	1928		1160	1220	2060	2060	SL(Unk), (Future FLP+CT)	-	OT	Direct
	1928		1400	817	3975	3975	SL(Unk), (Future FLP+CT)	-	OT	Direct
0060B	1963		3600	3561	2507	2507	T	SSP, FLP, CL, VF	RET 100	Indirect
	1942		2000	2188	3093	3093	T	SSP, FLP, CL, VF	RET 100	Indirect
0060F	1944		2200	1665	5968	130	-	T, VF, FLP, CT	RTP 56 RUP 42 RET 2	ES
0112	1955	1973	3000	2790	1512					
	1943	1972	2600	Down(2070)*	1176	[68]	FLP, NA, T, CT, VF	-	RTP 96	Direct
	1953	1975	3000	2436	1664					
	1960	1976	2000	1696	2857					
0112A	NR	1928	1700	1641	7722	1973	T, CLA, FLP	-	OT	Direct
	NR	1929	1700	1733	3822	2140	UNTREATED		OT	Direct
	NR	1959	2200	2266	2605					
	NR	1937	1800	2097	3159					
	1941		1800	Down(1700)*	5608					
	1948		3000	2664	3849	288	T, FLP, NA, CT	-	RTP 93	Direct
	1953		3740	3092	4042					
	1957		3200	Down(2800)*	4464					
0112B	NR	1965	1100	Down(1060)*						
	NR	1975	2500	2062						
	NR	1976	1850	981	2549	2549	T	-	OT	Direct
	NR	1967	1850	1660			(Future CT			
	NR	1969	2500	2211			and Recycle)			
	1972		2750	2657						
0112C	NR	1957	2600	2257	1085	1085	-	T, VF, (Future CT)	OT	Direct
	NR	1958	2600	2477	988	988	-	T, VF, (Future CT)	OT	Direct
0112D	1972		5500	4943	[1567]	[73]	T, FLP, NA, CT, VF	CLA, ML, NW, NA, FLP, CL, SS, T, VF, SL(Unk)	RTP 97	Direct
	1969		5000	5465						

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 2

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components		Operating Mode	Discharge Mode
							Process Treatment	Central Treatment		
0248A	1952		2000	1587	3902	3902	T, FLP, VF	-	OT	Direct
0256E	1953		2000	1381.5	5316	5316	T, VF	-	OT	Direct
0320	1920		NA	1625	2813	2813	T, VF	-	OT	Direct
	1922		NA	1638	1959	1959	T, VF	-	OT	Direct
	1948		NA	3007	1794	1794	T, VF	-	OT	Direct
0384A	1907		2150	1613	3958	254	SL(Unk), T, NA, FLP, O(2), CT	-	RTP 93	Direct
	1909		2100	1655	3288	211				
	1917	1963	2300	1767	3080	197				
	1926		2350	1689	3387	217				
	1939		3250	2461	3641	233				
	1942		3250	2319	3864	247				
	1947		3400	2374	2778	315	SL(Unk), NA, FLP, CT			
	1943		3400	2477	2663	302		-	RTP 89	Direct
0396A	1907	1963	2100	1852	1944	194	T, FLP, NA, CT, T, VF	-	RTP 90	POTW
	1909	1965	1300	1005	2866	287				
0396C	1903		1500	Down(1100)*	929	929	CL, FLP	-	RET 100	Indirect
	1905		1680	849	2205	2205				
0426	1958		1100	760	6632	2615	T, CT, NA, VF ·	SL(Unk)	RUP 61	Direct
0432A	1909	1962	2000	Down(2000)*			***		OT	Direct
							-	Scr, CLA, PSP, FLP, T, VF	OT	Direct
	1910	1970	3500	3057	[3091]	[3091]	-		RUP 27	Direct
	1910	1930	1500	1540			***		OT	Direct
							-		OT	Direct
	1912	1966	2500	Down(2300)*			-		RUP 40	Direct
	1919		1500	1347			-		OT	Direct
0432B	1900		1175	1487	872	872	CLA, T, FLP, VF	-	OT	Direct
	1966		2500	1529	1742	1742				
	1904		1600	Down(1550)*	1115	1115				
0432C	1952	1972	2227	2374	1213	229	Scr, FLP, T, O(3), VF	-	RTP 81	Direct
	1963		3140	2732	1318	249				

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 3

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components Process Treatment	Treatment Components Central Treatment	Operating Mode	Discharge Mode
0448A	1942		1675	1575	2743	NA	CL, SL(Unk), CT	-	RTP Unk RET Unk	ES and other processes & quenchs
	1949		1675	1661	2601	NA				
	1953		1675	1389	3110	NA				
	1959		2175	2085	3591	NA				
0492A	1947		1200	1540	2057	2057	-	CL, SL(Unk), SS, VF	RET 100	Indirect
0528A	1954		2500	2457	2066	62	-	NA, CL, FLP, VF, CT	RTP 97	Direct
	1958		2500	2546	2559	77				
0584B	1955		NA	2954	2025	2025	CL, T, VF	-	OT	Direct
	1941		NA	2605						
	1938		NA	2487						
	1952		NA	2620						
0584C	1956		2600	2099	3224	3224	-	PSP, SS, BOA(1), CLA, FDS(Unk)	OT	Direct
	1961		2600	2288	4406	4406				
0584D	1904		600	642	3892	3892	T, VF	-	OT	Direct
	1911		570	514	4861	4861				
	1911		980	998	2756	2756				
0584F	1919	1971	NA	2175	2317	2317	CL, VF	-	OT	Direct
	Pre 1940	1976	NA	1854	2718	2718				
	Pre 1940	1975	NA	1906	2644	2644				
	Pre 1940	1977	NA	1948	2587	2587				
0684A	1942		1260	1961	2203	2203	CL, VF	-	OT	Direct
	1926		1260	1565	3036	3036				
0684B	1921		2800	2565	3705	2582	UNTREATED	-	OT	Direct
						1123	T	-	OT	Direct
0684F	1908		2100	1837	5546	574	PSP, Scr, FLP, FLL, FLC, CL, SS, VF, NA, CT	-	RUP 45 RTP 44	Direct
	1916		1900	1745	5838	635			RUP 42 RTP 47	Direct
	1943		2600	1943	6096	469			RUP 36 RTP 56	Direct
	1952		2600	2017	5051	336			RUP 45 RTP 48	Direct
0684G	1918		1250	976	1202	1202	-	PSP, NL, NW, FLL, FLO(4), FLP, CL, SS, VF	OT	Direct
	1906		1900	1754	3272	2286			RUP 30	Direct

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 4

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components		Operating Mode	Discharge Mode
							Process Treatment	Central Treatment		
0684H	1943		2870	2532	[2345]	[188]	A, FLL, FLP, CLA, CL, VF, CT	-	RTP 92	POTW
0684I	1918		800	916	5235	5235	FLP, T, VF	SL(Unk), MW, SS	OT	Direct
	1942		1500	1784	4746	1534			RUP 32	Direct
						1679	-	Central Treatment Only		Direct
0724A	1902		1400	1177	795	697	T	-	RTP 12	Direct
	1902		1400	1433	1909	884			RTP 54	Direct
0732A	1952		800	1040	1800	0	T, O(4)	-	RTP (<100)	Direct
0856A	Inactive									
0856B	1943	1977	2500	1511	6490	2383	T, VF	-	RUP 37	Direct
						1725	UNTREATED	-	OT	Direct
	1943		2300	2016	4864	1786	T, VF	-	RUP 37	Direct
						1293	UNTREATED	-	OT	Direct
	1883		1800	1729	4464	999	T, VF	-	OT	Direct
						3465	UNTREATED	-	OT	Direct
	1886		1100	1246	4519	4334	T, VF	-	OT	Direct
						185	UNTREATED	-	OT	Direct
	1887		900	Down(972)*	9126	8889	T, VF	-	OT	Direct
						237	UNTREATED	-	OT	Direct
0856F	1952		2607	2700	1851	1851	T, FLL	-	OT	Direct
	1953		2820	2776	1800	1800				
	1957		2779	2872	1740	1740				
0856I	1901		NA	2241	3020	1092	FLP, CL, T, VF	-	OT	Direct
						1928	UNTREATED	-	OT	Direct
	1901		NA	2122	3189	1154	FLP, CL, T, VF	-	OT	Direct
						2036	UNTREATED	-	OT	Direct
	1907		NA	1118	4250	4250	T, VF	-	OT	Direct
	1907		NA	1036	4587	4587				
0856N	1898		NA	Down(1100)*	1047	1047	T, SL(Unk)	-	OT	Direct
	1899		NA	1346	856	856				
	1942		NA	2326	532	532				
	1907		NA	Down(1100)*	1571	1571				
	1941		NA	2718	1595	1001				
						593	UNTREATED		OT	Direct

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
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Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0856O	1954		1234	1090	2202	2202	T, FLP	-	OT	Direct
0856Q	1907		1100	1009	6708	UNK	T, VF	-	RTP, RET 100	ES
0856R	1896		1000	Down(950)*	4030	1612	T, VF	-	RTP 60	Direct
	1897		1250	1100						
	1897		1500	1451						
	1963		3000	2843	2431	2431	T, VF	-	OT	Direct
0856T	1901		1639	1666	2224	1443	PSP	-	OT	Direct
						781	UNTREATED	-	OT	Direct
	1901		1517	1634	1983	1983	PSP	-	OT	Direct
	1909		1551	Down(1079)*	3059	1204	PSP	-	OT	Direct
						1855	UNTREATED		OT	Direct
0860B	1917		894	1061	5282	5282	-	SL(Unk), FLP, CL (Future T, CLA, CAG and recycle)	OT	Direct
	1917		1959	2337	1658	1658			OT	Direct
	1911		888	613	6098	6098			OT	Direct
	1910		1980	1485	4935	4935			OT	Direct
	1909		1981	1708	4755	3406			RUP 28	Direct
	1909		1721	1910	4161	4161			OT	Direct
	1909		980	564	12,176	12,176			OT	Direct
	1909		1818	1903	2634	2634			OT	Direct
	1908		1105	1247	2721	2721			OT	Direct
	1908		1137	1360	3543	3543			OT	Direct
	1974		6148	5022	3297	358 (No Discharge)	FLP, T, VF, CT	-	RTP 89	ES
0860H										
	1970		4000	3073	2905	120	PSP, Scr, FLP, CL, T, VF, CT	-	RUP 32	ES
	1928		1512	1516	2945				RTP 64	
	1948		2200	2360	2227				RTP 96	
	1948		2200	Down(1958)*	3530				RTP 96	
									RTP 96	
0864A	1944		1900	1344	3482	1741	CL, SL(Unk)	Central Treatment present, but not described	RTP 50	Direct
	1944		1900	1344	3482	1741				
	1944		1900	1344	3482	1741				

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
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Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0868A	1908		959	850	2095	1903	SL(Unk)	-	OT	Direct
	1908		1096	861		192	UNTREATED		OT	Direct
	1908		959	915						
	1928		1370	1109	[4350]	[149]	FLP, T, SL(Unk), CT	SL(Unk)	RUP 37 RTP 59	Direct
	1928		1370	1292	[3734]	[128]			RUP 37 RTP 59	Direct
	1941		2300	1728	[2917]	[100]			RUP 37 RTP 59	Direct
0920A	1903	1976	1550	1482	2915	2915	Scr, T, VF	-	OT	Direct
	1904	1969	1550	1279	3378	3378			OT	Direct
0920B	1913		1000	973	[2664]	[95]	-	PSP, FLP, CL, T, NA, VF, CT	RTP 96	Direct Direct
	1913		1000	Down(1000)*	[2592]	[92]	-		RTP 96	Direct Direct
	1948		2400	2192	[2891]	[74]	-		RUP27 RTP70	Direct
0920N	1948		1500	1502	2167	2167	T, VF	-	OT	Direct
	1950		900	Down(647)*	5030	5030	T, VF	-	OT	Direct
	1948		1800	1850	3795	1459	T, VF	-	RUP 38	Direct
0946A	1908		1000	Down(930)*	3220	2267	-	NC, CLA, FLP, T, VF FDSP	RTP 30	Direct
	1930		1400	1484						
0948A	1908	1929	1200	1274	1808	93 904	T, VF UNTREATED	-	RTP 45 OT	Direct Direct
	1908	1936	1200	Down(1000)*	2160	104 1152	T, VF UNTREATED	-	RTP 42 OT	Direct Direct
	1910	1940	1500	1268	2271	117 1136	T, VF UNTREATED	-	RTP 45 OT	Direct Direct
	1913	1942	1500	1742	951	96	T, VF	-	RTP 90	Direct
0948B	1918		1055	925	3892	3892	PSP	-	OT	Direct
0948C	1917	1948	2500	Down(1800)*	3152	82	T, VF, CT	-	RUP 48, RTP 50	Direct
	1925		1400	Down(1000)*	4896	158			RUP 35, RTP 61	Direct
	1953		2800	2526	1824	91			RTP 95	Direct
	1967		4000	4018	2724	82			RUP 39, RTP 58	Direct

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACE
PAGE 7

* : Furnace was down in 1976; the value in parentheses represents 1975 average production.
** : Presented in English units for convenience of industry and government accustomed to working with English units. Multiply these values by 4.17 to convert to metric units.
***: A portion of the wastewater flow from this furnace is discharged untreated.
NR : No Response provided in the DCP.
[ ] : Data enclosed in brackets was provided in D-DCP responses or obtained during sampling visits.

KEY TO C&TT COMPONENTS

(1) Ferrous Sulfate
(2) Thermal Rotors
(3) Screw Classifier
(4) Sieve Plates

For definitions of the other C&TT Codes, and other abbreviations, refer to Table VII-1.

TABLE III-2

GENERAL SUMMARY TABLE
FERROMANGANESE BLAST FURNACE

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components		Operating Mode	Discharge Mode
							Process Treatment	Central Treatment		
0112C	1925		676	534	[11,538]	[0]	CL, T, VF, CT	-	RTP 100	No discharge to navigable waters.

[ ]: Data enclosed in brackets was obtained during a sampling visit.

NOTE: For a definition of C&TT codes, and other abbreviations, refer to Table VII-1.

TABLE III-3

IRONMAKING DATA BASE

	No. of Plants	Percent of Total No. of Plants	Rated Capacity (Tons/day)	Percent of Rated Capacity
Plants sampled for original study	4	7.4	15,200	4.7
Plants sampled for toxic pollutant study	7	13.0	54,080*	16.8
Total plants sampled	11	20.4	69,280*	21.5
Plants responding via D-DCP	7	13.0	62,050	19.3
Plants sampled and/or responding via D-DCP(1)	15	27.8	116,640*	36.2
Plants which responded to DCP	54	100	321,850*	100.0

---

(1) Three plants which responded via D-DCP were also sampled during the toxic pollutant survey.

* : Does not include the tonnage of the confidential plant.

TABLE III-4

BLAST FURNACE PRODUCTION
PLANTS RANKED FROM HIGHEST TO LOWEST PRODUCTION
(TONS PER DAY - RATED CAPACITY)

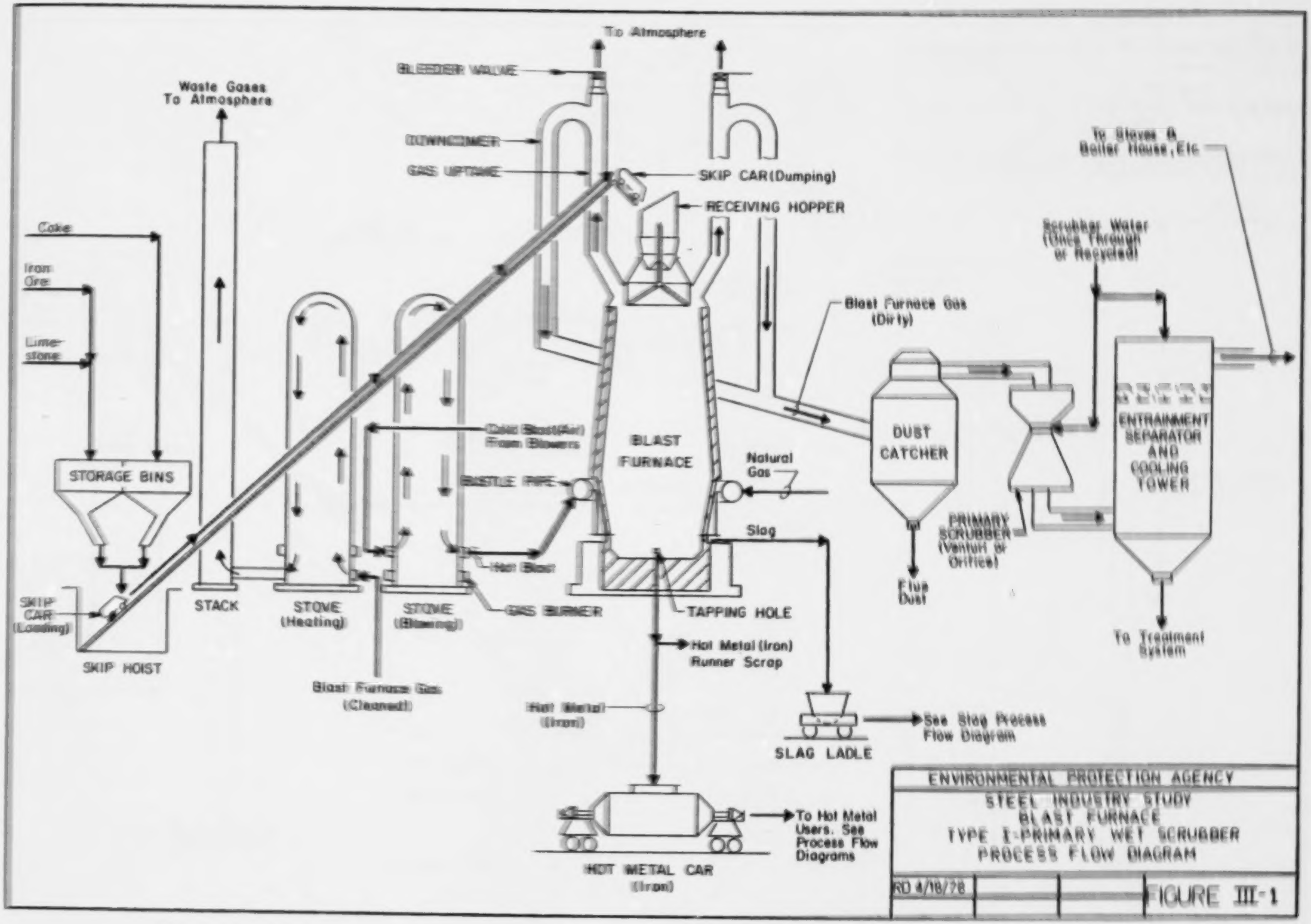
Reference Number	Rated Capacity TPD
0384A	22,200
0860B	20,611
0112A	19,140
0112B	12,550
0432A	11,000
0948C	10,700
*0584B	10,666
0112	10,600
0112D	10,500
0860H	9,912
0684F	9,200
0856B	8,600
*0856N	8,590
0856F	8,206
0868A	8,054
*0584F	7,883
0448A	7,200
0856R	6,750
*0856I	6,517
0320	6,270
0864A	5,700
0060B	5,600
0948A	5,400
0432C	5,367
0432B	5,275
0112C	5,200
0584C	5,200
0528A	5,000
0060	4,730
0856T	4,707
0920B	4,400
0920N	4,200
0946A	3,400
0396C	3,180
0684G	3,150
0920A	3,100
0684H	2,870
0684B	2,800

TABLE III-4
BLAST FURNACE PRODUCTION
PLANTS RANKED FROM HIGHEST TO LOWEST PRODUCTION
(TONS PER DAY - RATED CAPACITY)
PAGE 2

Reference Number	Rated Capacity TPD
0724A	2,800
0060A	2,560
0684A	2,520
0396A	2,400
0684I	2,300
0060F	2,200
0584D	2,150
0248A	2,000
0256E	2,000
0856O	1,234
0492A	1,200
0426	1,100
0856Q	1,100
0948B	1,055
0732A	800
	321,847

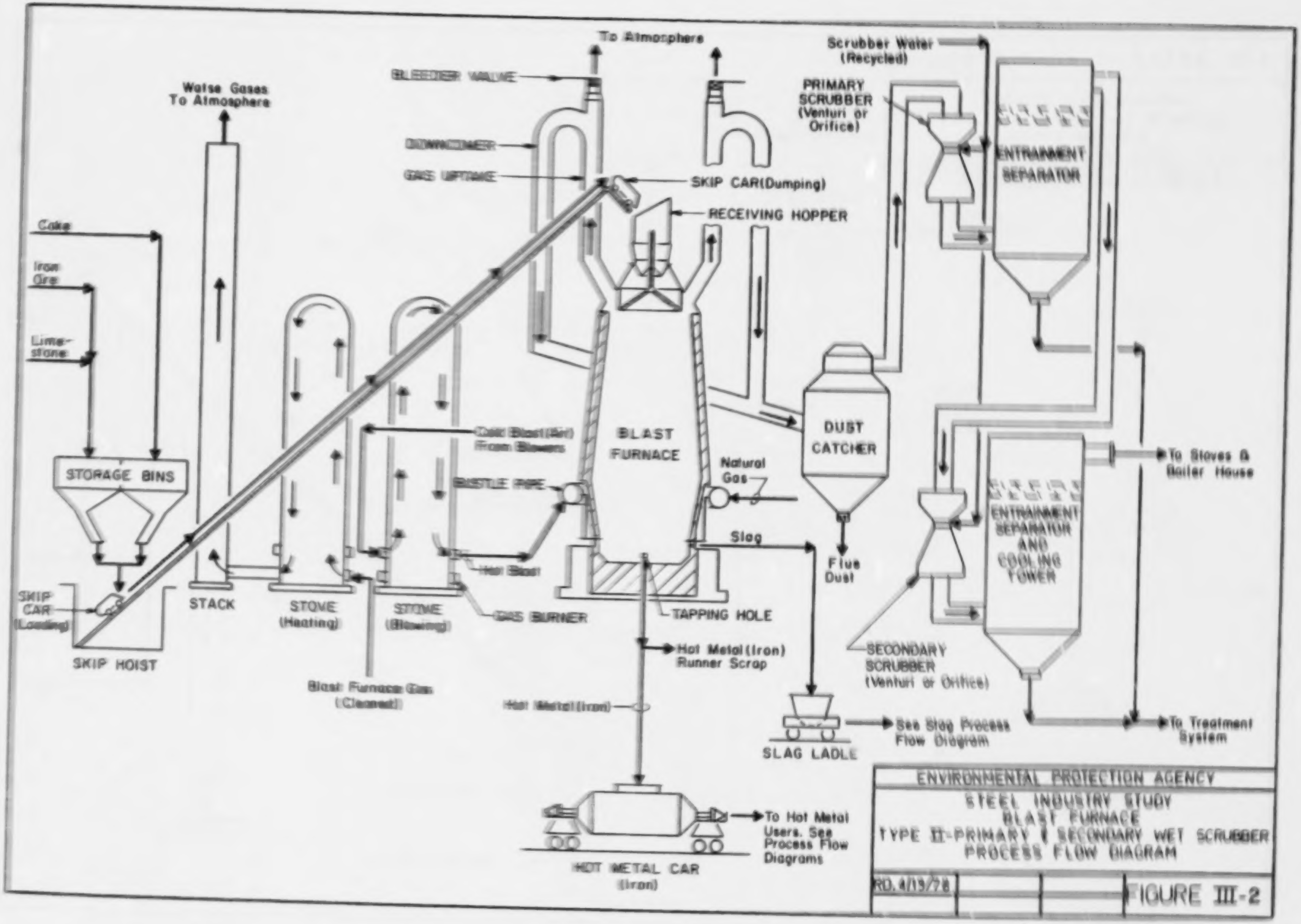
---

*Based on 1976 production - rated capacity not available.


To Atmosphere
BLEEDER VALVE
Waste Gases
To Atmosphere
DOWNCOMER
GAS UPTAKE
SKIP CAR (Dumping)
RECEIVING HOPPER
To Stoves &
Boiler House, Etc
Coke
Iron
Ore
Lime-
stone
Scrubber Water
(Once Through
or Recycled)
Blast Furnace Gas
(Dirty)
Cold Blast (Air)
From Blowers
BLAST
FURNACE
Natural
Gas
DUST
CATCHER
ENTRAINMENT
SEPARATOR
AND
COOLING
TOWER
STORAGE BINS
BUSTLE PIPE
Slag
PRIMARY
SCRUBBER
(Venturi or
Orifice)
Hot Blast
Flue
Dust
SKIP
CAR
(Loading)
STACK
STOVE
(Heating)
STOVE
(Blowing)
GAS BURNER
TAPPING HOLE
To Treatment
System
SKIP HOIST
Hot Metal (Iron)
Runner Scrap
Blast Furnace Gas
(Cleaned)
Hot Metal
(Iron)
See Slag Process
Flow Diagram
SLAG LADLE
To Hot Metal
Users. See
Process Flow
Diagrams
HOT METAL CAR
(Iron)
RD 4/18/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
TYPE I-PRIMARY WET SCRUBBER
PROCESS FLOW DIAGRAM

FIGURE III-1

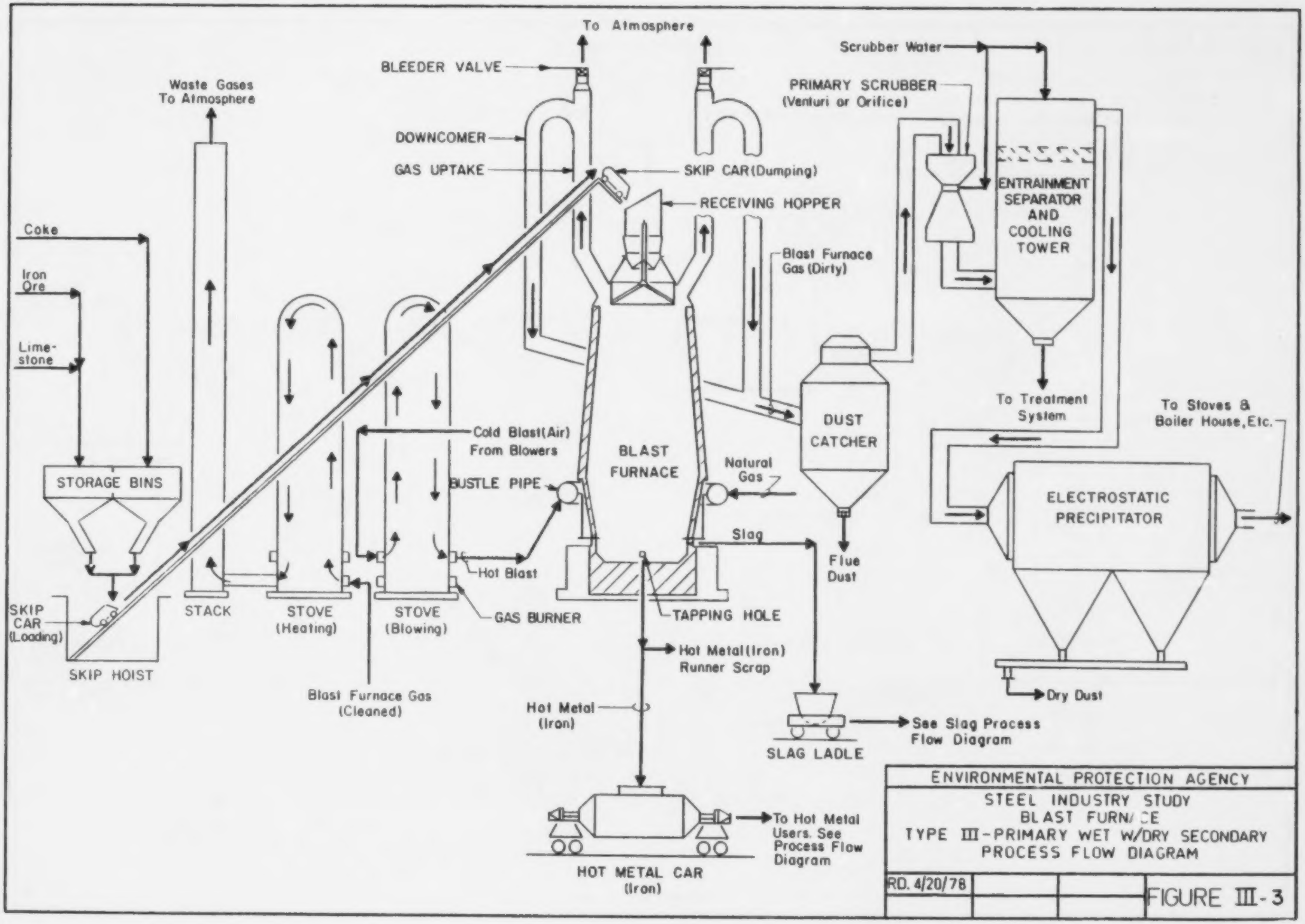

To Atmosphere
Scrubber Water (Recycled)
PRIMARY SCRUBBER (Venturi or Orifice)
Waste Gases To Atmosphere
BLEEDER VALVE
DOWNCOMER
GAS UPTAKE
SKIP CAR(Dumping)
RECEIVING HOPPER
ENTRAINMENT SEPARATOR
Coke
Iron Ore
Limestone
Cold Blast (Air) From Blowers
BLAST FURNACE
DUST CATCHER
To Stoves & Boiler House
STORAGE BINS
BUSTLE PIPE
Natural Gas
ENTRAINMENT SEPARATOR AND COOLING TOWER
Slag
Flue Dust
Hot Blast
SKIP CAR (Loading)
STACK
STOVE (Heating)
STOVE (Blowing)
GAS BURNER
TAPPING HOLE
SKIP HOIST
Hot Metal (Iron) Runner Scrap
SECONDARY SCRUBBER (Venturi or Orifice)
Blast Furnace Gas (Cleaned)
Hot Metal (Iron)
See Slag Process Flow Diagram
To Treatment System
SLAG LADLE
To Hot Metal Users. See Process Flow Diagrams
HOT METAL CAR (Iron)

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE
TYPE II-PRIMARY & SECONDARY WET SCRUBBER
PROCESS FLOW DIAGRAM

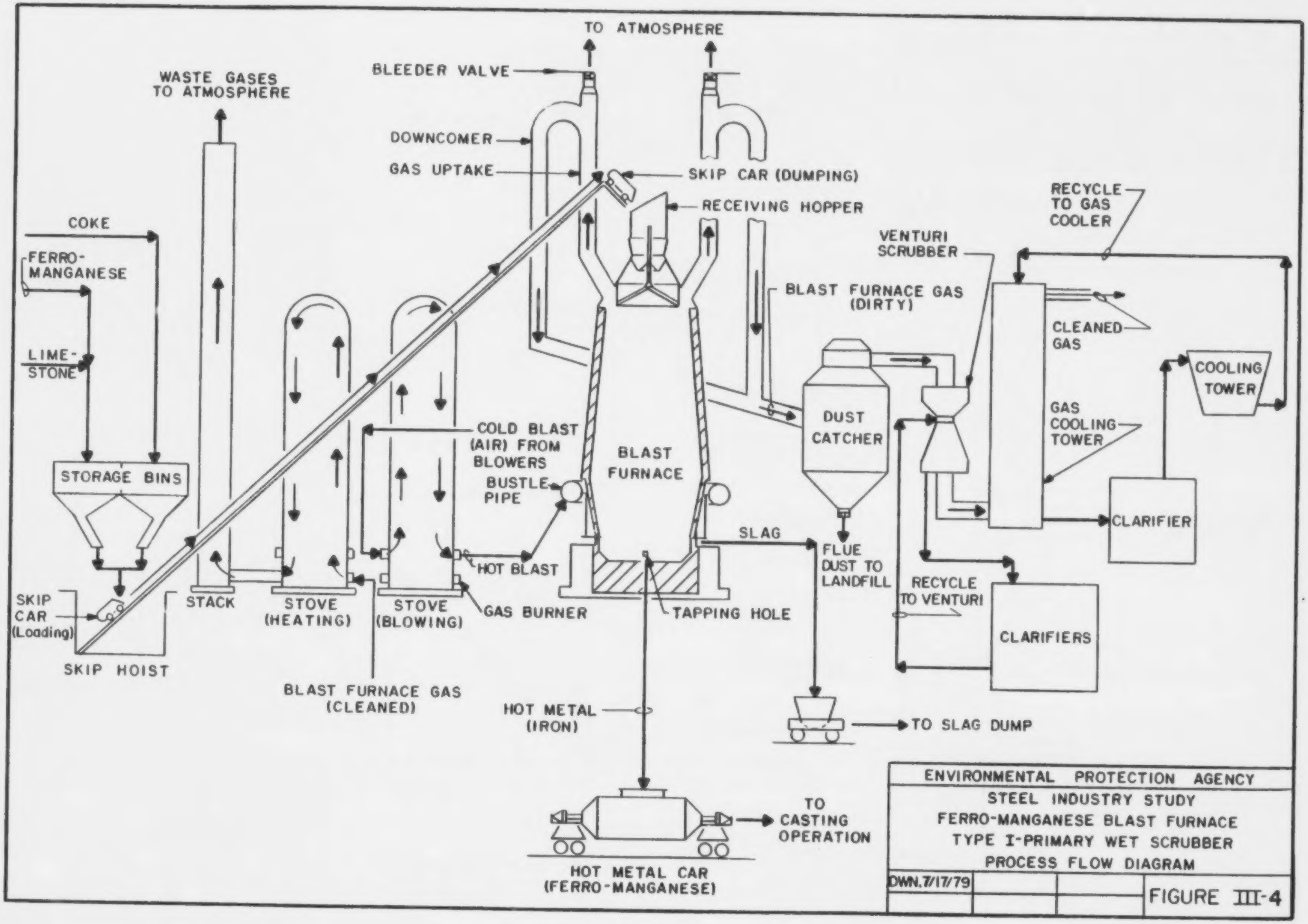
RD. 4/13/78

FIGURE III-2


To Atmosphere
BLEEDER VALVE
Waste Gases To Atmosphere
DOWNCOMER
GAS UPTAKE
SKIP CAR (Dumping)
RECEIVING HOPPER
Coke
Iron Ore
Lime-stone
STORAGE BINS
SKIP CAR (Loading)
SKIP HOIST
STACK
STOVE (Heating)
STOVE (Blowing)
Cold Blast (Air) From Blowers
BUSTLE PIPE
Hot Blast
GAS BURNER
Blast Furnace Gas (Cleaned)
BLAST FURNACE
Natural Gas
Slag
TAPPING HOLE
Hot Metal (Iron) Runner Scrap
Hot Metal (Iron)
HOT METAL CAR (Iron)
To Hot Metal Users. See Process Flow Diagram
Blast Furnace Gas (Dirty)
DUST CATCHER
Flue Dust
SLAG LADLE
See Slag Process Flow Diagram
Scrubber Water
PRIMARY SCRUBBER (Venturi or Orifice)
ENTRAINMENT SEPARATOR AND COOLING TOWER
To Treatment System
To Stoves & Boiler House, Etc.
ELECTROSTATIC PRECIPITATOR
Dry Dust
RD. 4/20/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
TYPE III - PRIMARY WET W/DRY SECONDARY
PROCESS FLOW DIAGRAM

FIGURE III-3



TO ATMOSPHERE
BLEEDER VALVE
WASTE GASES TO ATMOSPHERE
DOWNCOMER
GAS UPTAKE
SKIP CAR (DUMPING)
RECEIVING HOPPER
COKE
FERRO-MANGANESE
LIME-STONE
RECYCLE TO GAS COOLER
VENTURI SCRUBBER
BLAST FURNACE GAS (DIRTY)
CLEANED GAS
COOLING TOWER
GAS COOLING TOWER
DUST CATCHER
COLD BLAST (AIR) FROM BLOWERS
BLAST FURNACE
BUSTLE PIPE
STORAGE BINS
CLARIFIER
SLAG
FLUE DUST TO LANDFILL
HOT BLAST
RECYCLE TO VENTURI
SKIP CAR (Loading)
STACK
STOVE (HEATING)
STOVE (BLOWING)
GAS BURNER
TAPPING HOLE
CLARIFIERS
SKIP HOIST
BLAST FURNACE GAS (CLEANED)
HOT METAL (IRON)
TO SLAG DUMP
TO CASTING OPERATION
HOT METAL CAR (FERRO-MANGANESE)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
FERRO-MANGANESE BLAST FURNACE
TYPE I-PRIMARY WET SCRUBBER
PROCESS FLOW DIAGRAM

DWN. 7/17/79

FIGURE III-4

IRONMAKING SUBCATEGORY

SECTION IV

SUBCATEGORIZATION

Introduction

The steel industry is comprised of separate and distinct processes. Industry subcategorization was primarily affected by the individual processes, products, and wastewater characteristics. Other factors considered for subdivision were: raw materials, wastewater treatability, size, age, geographic location, and process water usage. With regard to ironmaking operations, differences between iron and ferromanganese blast furnaces were identified and found to justify subdividing the ironmaking subcategory. A discussion of each of these factors and the proposed subdivision follows.

Factors Considered in Subcategorization

Manufacturing Process and Equipment

The production of iron and ferromanganese is unique within the steel industry because it is the only process in which iron bearing material, limestone and coke are converted into molten iron or ferromanganese. While many refinements have been made to blast furnaces to improve operating efficiencies, the basic process has remained unchanged. These changes include more stringent control of the quality of raw materials, reaction rates and times within the furnace, the use of high top pressures, and oxygen and oil injection. These refinements have not significantly affected the quality or quantity of the wastewaters generated during the ironmaking process.

Final Product

Various grades of iron may be produced in a blast furnace (e.g., basic iron, ferromanganese, spiegeleisen, ferrophosphorus, alloy iron), however, more than 99% of the iron produced is basic iron. Less than 1 percent of total blast furnace production was attributed to ferromanganese production. A review of the DCP data reveals that only five U.S. blast furnaces have historically produced iron other than pig iron and these furnaces produced only ferromanganese. Two of these five furnaces produced over 95% of the ferromanganese made in this country. At this writing, there are no ferromanganese furnaces in operation.

Raw Materials

The major raw materials used in the blast furnace process are coke, iron ore, limestone, pellets, and sinter. Secondary raw materials include scrap, gravel, tars and oils of various types, mill scale, flux and dolomite. Following is a summary of the major raw materials used in the iron furnaces:

Feed Material	Mean % of Burden	Mean lb/ton of Hot Metal
Coke	26.1	1,259
Iron Ore	14.0	744
Pellets	38.8	1,811
Sinter	23.7	1,096

For the one ferromanganese furnace, the raw material composition consisted of coke (36%), ferromanganese ore (47%), stone (12%) and other materials (5%). The use of large quantities of ferromanganese ore in the production of ferromanganese iron was a factor which distinguishes this process from the basic iron process. Other raw material differences were minor and, as such, did not warrant further subdivision of the ironmaking subcategory.

Wastewater Characteristics

Ironmaking process wastewaters are generated as the direct result of cleaning (i.e., scrubbing) and cooling the dirty exhaust (top) gases. Top gases are cleaned and cooled so that they may be reused as fuel. The scrubbing and cooling is accomplished with water which removes dust and other pollutants in the gas stream. The quantity of particulate matter which is transferred from the gas stream to the scrubbing waters is primarily related to the gas stream quality and the efficiency of the scrubber operation.

The gas streams contain dust, quantities of raw materials and process reaction products. For example, many of the same pollutants found in coke plant wastewaters are also found in ironmaking wastewaters. The phenolic pollutants found in ironmaking wastewaters are attributable to the coke used in the ironmaking process. Cyanide and ammonia (reaction products formed within the furnace or transferred from the coke charge to the furnace gases) are carried over with the gas stream and transferred to the scrubbing waters.

Various types of wet gas cleaning systems are used in the ironmaking subcategory (e.g., venturi scrubbers, adjustable orifice scrubbers, separators, spray chambers). The amount of pollutants transferred from the gas stream to the scrubbing water can vary among the various types of gas cleaning equipment, however, the differences are not significant.

Wastewater Treatability

The basic treatment for ironmaking wastewaters is the removal of suspended solids by gravity sedimentation. Other pollutants (e.g., metals) associated with the suspended solids are also substantially removed by the settling process. The treatment of blast furnace wastewaters is similar throughout the subcategory and, as a result, subdivision on the basis of wastewater treatability is not warranted.

Similar treatment was provided for the ferromanganese furnace, which was operating during the original study.

Size and Age

The Agency considered the impact of size and age of blast furnace facilities on the subdivision of ironmaking operations. The Agency determined that age was of little importance because blast furnaces require periodic major rebuilding, typically every five to ten years. During these major rebuilds, substantial modifications to the furnace are incorporated, which, in essence, is comparable to the construction of a new furnace. Most existing blast furnaces have been rebuilt many times, and some furnaces originally built in the early 1900's are still operating today. As the furnaces have been rebuilt, various technological and production advancements have been incorporated to improve furnace operation.

Figure IV-1 is a plot of effluent flow vs. plant age for plants with treatment and recycle facilities. This diagram shows that there is no relation between effluent flow and plant age, especially with flows less than 125 gal/ton (the BPT model flow). Effluent flow provides a measure of treatment capability, as recycle is one of the major treatment components used in developing the BPT, BAT, NSPS, PSES and PSNS alternative treatment systems and respective effluent limitations and standards.

Despite the fact that age of a blast furnace is a meaningless term, the Agency investigated the effect of age on the feasibility and cost of retrofitting pollution control equipment at blast furnaces. The comparison of the age of a blast furnace with the year in which pollution control facilities were installed (see Table IV-1), demonstrates that pollution control equipment can be retrofitted. The discussions in the preceding paragraphs show that similar rates of pollutant discharge are achievable at blast furnaces of all ages. As a result, the Agency has concluded that retrofitting pollution control facilities to blast furnaces is feasible.

The cost of retrofitting the BPT systems to blast furnaces were provided by industry in its DCP responses. The data, where clearly identifiable, show that retrofit costs amount to about 5 percent of the total capital cost of the pollution control equipment. In addition, as shown in Section VIII of this volume, comparison of actual costs incurred by industry with the Agency's estimated costs for the same pollution control facilities, show that the Agency's estimates are sufficient to account for any retrofit and other site-specific costs. The Agency thus concludes that the cost of retrofitting pollution control equipment at blast furnaces is minimal.

In addition, since more than 90 percent of the blast furnaces in the United States have retrofitted BPT at existing operations, the feasibility is well demonstrated. BAT, on the other hand, requires add-on treatment which does not require retrofitting.

The Agency evaluated the question of size by plotting effluent flow vs. production (Figure IV-2). This diagram shows that there is no relation between effluent flow and plant size as indicated by treatment and recycle facilities. It also demonstrates that the lower flows (representative of BPT and BAT model systems) were observed in older as well as newer blast furnace operations. The Agency found that many plant sites have several blast furnaces. These furnaces range from old to new, and from small to large capacity.

Based upon the foregoing evaluation, the Agency concluded that there is no need to subdivide the ironmaking subcategory on the basis of age or size.

Geographic Location

Location has little apparent effect upon subdivision. Most blast furnaces are located in the predominant steel producing areas (e.g., Chicago, Pittsburgh, Cleveland). A few plants are located in water scarce areas and, as a result, these plants use operational methods (e.g., wastewater recirculation) which conserve water. As of July 1, 1978 about 54 percent of the plants (distributed throughout the country) had recycle systems for at least a portion of their wastewaters, recirculation is not unique to geographic location. Currently, recycle systems are installed at about 90 percent of the blast furnaces in the country. Also, wastewater quality among the eight plants surveyed was basically similar and, of the surveyed plants, one was located in an arid or semi-arid region, one in the southwest, and the others in the midwest and east.

Process Water Usage

The Agency examined process water usage as a possible basis for further subdivision. The data indicated that process wastewater flow had no significant impact on the ability to treat process wastewaters. In fact, many of the plants with the highest applied flows have lower discharge flows than plants with lesser applied flows. Based on these factors, the Agency concluded that further subdivision of the ironmaking subcategory based on process water usage is not warranted.

TABLE IV-1

EXAMPLES OF RETROFIT
IRONMAKING SUBCATEGORY

		Plant Age	Treatment Age
Blast Furnace	060B	1942	1958
	112A	1941	1948
	320	1920-1947	1976
	396A	1907-1909	1929
	396C	1903-1905	1929
	426	1958	1979
	432A	1910-1919	1951
	432B	1900-1966	1930
	584C	1956-1961	1965
	584D	1904-1911	1953
	And others		

FIGURE IV-1

BLAST FURNACE-RECYCLING PLANTS

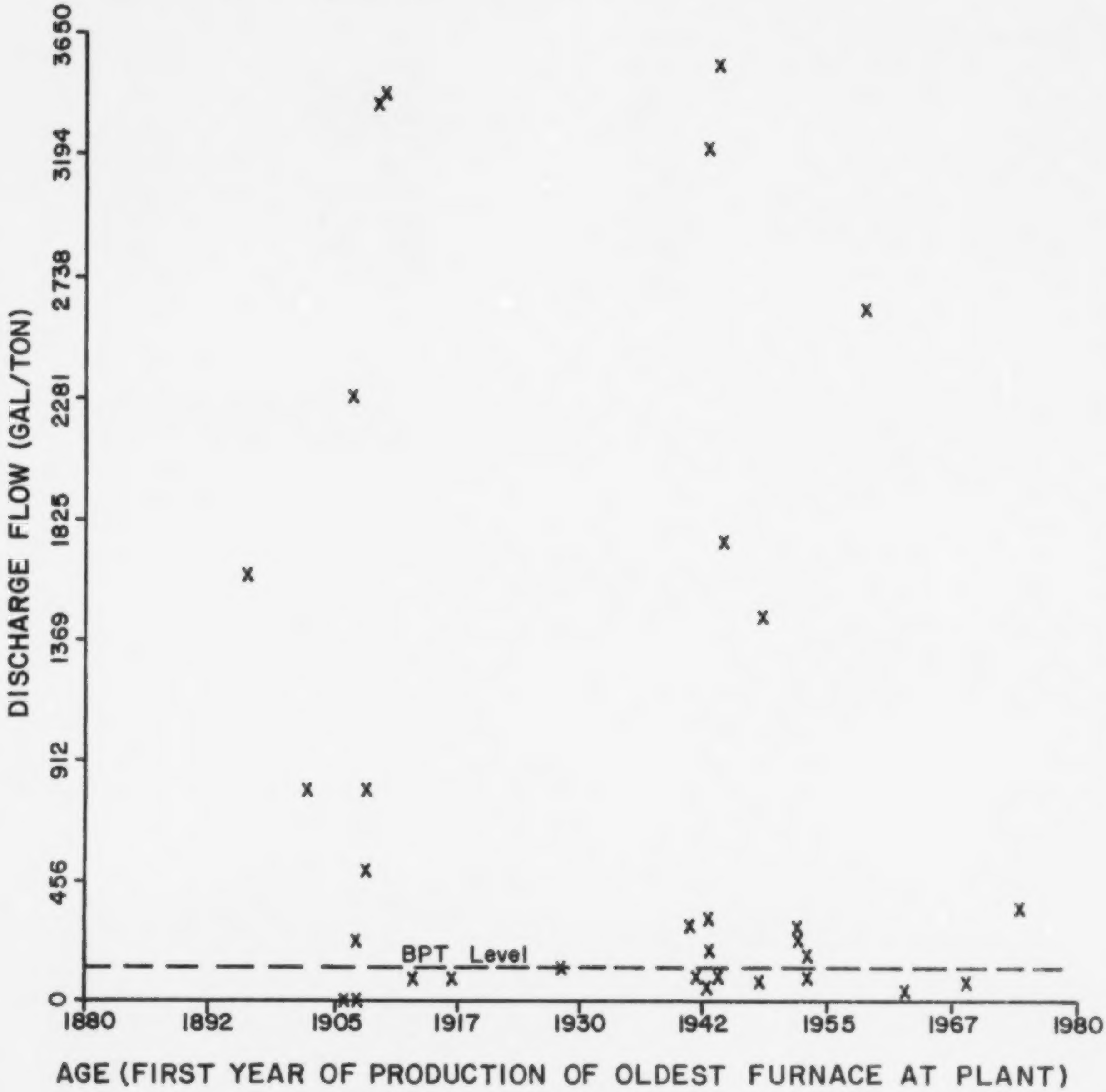
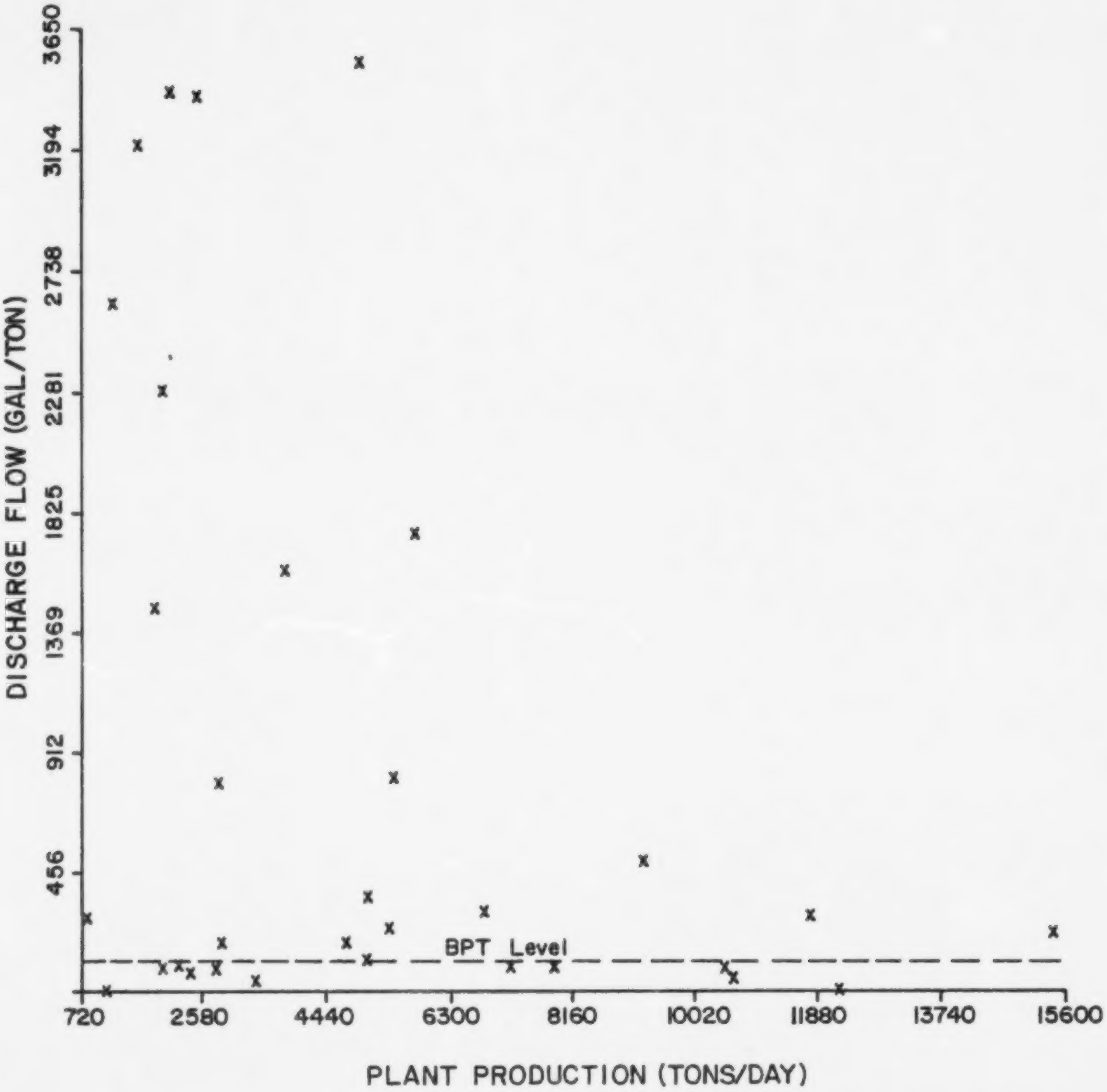


FIGURE IV-2

BLAST FURNACE-RECYCLING PLANTS



IRONMAKING SUBCATEGORY

SECTION V

WATER USE AND WASTE CHARACTERIZATION

Introduction

Process water usage plays a major role in the determination of pollutant loads and pollutant removal cost estimates. The Agency used data from the sampling visits and the DCPs to evaluate process water use; to estimate pollutant loads; to obtain total wastewater volumes; and to identify the wastewater treatment technology in place at each plant.

This section presents data which characterize the wastewater streams originating in blast furnace operations. The wastewater characterization is based upon data obtained during the two field sampling programs conducted at one ferromanganese and eight iron blast furnace operations. During the original sampling program the Agency measured the levels of the polllutants limited under the originally promulgated effluent guidelines. During the second field sampling program the levels of those pollutants were again measured, while additional monitoring was performed for toxic pollutants. To confirm and expand upon the toxic pollutant survey data, the Agency conducted sampling visits at three additional blast furnace sites (plants 0112, 0684F, and 0860H). The Agency has incorporated data from these visits in the existing data base. The Agency did not observe any significant differences in the basic character of the process wastewaters during these visits.

Description of the Ironmaking Operation and Wastewater Sources

The water use rates discussed below pertain only to process wastewaters, and do not include noncontact cooling or nonprocess waters. Process wastewater is defined as water which has come into direct contact with the process, products, exit gases, and raw materials associated with blast furnace operations. The wastewaters, thereby, become contaminated with the various pollutants characteristic of the process. Noncontact cooling water is defined as that water used for cooling which does not come into direct contact with the processes, products, by-products, or raw materials. Nonprocess water is defined as that water which is used in nonprocess operations, such as for utility and maintenance requirements.

Water is used within the blast furnace operation for two purposes: (1) to cool the furnace, stoves, and ancillary facilities, and (2) to clean and cool the furnace top gases. Although blast furnace wastewaters are primarily the result of the gas cleaning and cooling processes, there are other wastewaters sources. During the plant visits, the Agency found additional wastewaters from a dekishing operation (plant 0432A, which treated these wastewaters with sintering wastewaters) and from a slag quench wastewater treatment operation (plant 0112D). Other miscellaneous waters such as floor drains, and drip legs, are also included as part of the process wastewaters, but, as mentioned above, the gas scrubber and cooler wastewater is the primary, and most important, ironmaking wastewater.

The industry provided process wastewater and treated effluent flow data in the DCP responses. In many instances these data were reported as measured values, but some were reported as best engineering judgment or design values. In most instances DCP data provided the bases for the flows listed on the summary table, however, where available, plant visit or D-DCP information was used in lieu of the DCP data. Plant process wastewater flows varied over a wide range (1034 to 6708 gal/ton) and, likewise, plant effluent flows also spanned a wide range (0 to 3902 gal/ton). This wide range in flows can be attributed to several factors, but scrubber design and efficiency, the number of scrubbers used, and gas cooling requirements generally are the principal factors dictating water usage rates. The effluent flow rates are affected by the treatment practices, principally recycle, employed. There is no indication that industry adjusts process water usage to meet reduced or increased production demands.

One method of conserving water, and reducing the quantities of pollutants discharged, is recycle. Recirculation of ironmaking wastewaters is currently practiced by a substantial majority of the plants and is identified as a major component in the BPT model treatment system. Although recirculation may result in an increase in the concentration of certain inorganic pollutants in the recycled wastewater, the significant reduction in discharge flow which results from recycle reduces the total pollutant load discharged.

Blast furnace wastewaters contain suspended particulate matter, cyanide, phenol and ammonia; all of which are limited by current NPDES permits. Other wastewater pollutants include toxic metals and certain toxic organic pollutants which originate in the raw materials or form during the reduction process. The concentration data presented in Tables V-1 through V-4 provide a measure of the significant pollutants contributed during each pass through the process. After reviewing the data, the Agency determined that the effect of makeup water quality on these streams is negligible. Accordingly, the proposed effluent limitations and standards are based solely on gross values.

TABLE V-1

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
IRON MAKING BLAST FURNACES

Pick-up per pass concentrations (mg/l) in raw process wastewaters

Reference Code	0946A	0396A	0448A	0060F	
Plant Code	L	M	N	O	
Sample Point(s)	1-(6+8)	1-(2+4)	1-(2+5)	1-(4+5)	
Flow, gal/ton	5,400	2,057	3,350	3,123	Average
Ammonia (as N)	1.19	2.70	7.98	10.1	5.49
121 Cyanide (Total)	1.42	0.806	1.68	-	0.976
Phenols	0.120	-	0.529	0.085	0.184
Fluoride	0.15	1.3	2.24	-	0.92
Suspended Solids	72	611	306	1,167	539
pH	6.6	7.1-8.3	6.6	7.4-7.5	6.6-8.3

- : Calculation results in a negative value.

TABLE V-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES

Pick-up per pass concentrations (mg/l) in raw process wastewaters

	Reference Code	0196A	0112D	0432A	0684H		
	Plant Code	021	026	027	028		
	Sample Point(s)	(B-D)	(G+K)-(I+M+N)	(C-A)	B-(A+C)		
	Flow, gal/ton	1257	1711	3091	2277	Average	Overall Average(1)
	Ammonia (as N)	20.4	16.2	17	10	15.9	10.7
121	Cyanide (Total)	15.8	0.008	12.04	0.079	6.98	3.98
	Phenols	-	0.052	2.91	0.67	0.908	0.546
	Fluoride	3.6	-	6.5	1.4	2.9	1.9
	Suspended Solids	3502	445	1613	1602	1790	1165
	pH	8.4-8.9	6.4-7.1	9.2-9.7	10.2	6.4-10.2	6.4-10.2
9	Hexachlorobenzene	0.155	ND	ND	ND	0.039	0.039
23	Chloroform	-	-	0.014	-	0.004	0.004
31	2,4-Dichlorophenol	ND	ND	ND	0.201	0.050	0.050
34	2,4-Dimethylphenol	ND	-	0.053	0.003	0.014	0.014
39	Fluoranthene	15.95	0.001	0.082	ND	4.008	4.008
55	Naphthalene	0.018	0.012	ND	-	0.008	0.008
65	Phenol	2.14	ND	0.595	-	0.684	0.684
73	Benzo(a)pyrene	14.19	0.001	0.003	ND	3.548	3.548
76	Chrysene	0.420	0.012	0	ND	0.108	0.108
80	Fluorene	-	0.020	0.009	ND	0.007	0.007
84	Pyrene	15.10	0.007	0.053	ND	3.79	3.79
114	Antimony	NA	NA	0.033	NA	0.033	0.033
115	Arsenic	NA	NA	0.041	NA	0.041	0.041
118	Cadmium	0.036	-	#	0.143	0.060	0.060
119	Chromium	0.040	0.046	0.357	0.625	0.27	0.27
120	Copper	0.10	-	0.113	1.140	0.34	0.34
122	Lead	53.5	0.95	#	#	27.2	27.2
124	Nickel	0.10	0.010	#	1.146	0.42	0.42
125	Selenium	NA	NA	0.058	NA	0.058	0.058
126	Silver	0.040	0.002	#	0.068	0.037	0.037
128	Zinc	59.9	4.5	19.95	#	28.1	28.1

- : Calculation results in a negative value
ND : Not Detected
NA : Not Analyzed
# : Values are qualified, resulting in insufficient data to complete net raw concentration evaluation.
(1): Based upon the average of all data presented in Tables V-1 and V-2.

TABLE V-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
FERROMANGANESE BLAST FURNACE

Pick-up per pass concentrations in (mg/l) raw process wastewaters

	Gas Scrubber	Gas Cooler
Reference Code	0112C	0112C
Plant Code	Q	Q
Sample Point(s)	2-(4+1)	5-4
Flow, gal/ton	2,233	5,705
Ammonia (as N)	-	136
121 Cyanide (Total)	-	105
Phenols	-	0.461
Manganese	2,946	5.41
Suspended Solids	17,193	50
pH	12.1-12.2	8.6-8.7

- : Calculation results in a negative value.

TABLE V-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
FERROMANGANESE BLAST FURNACE

Pick-up per pass concentrations (mg/l) in raw process wastewaters

Reference Code	0112C
Plant Code	025
Sample Points	(B+D) - (C+E)
Flow, gal/ton	11,540
Ammonia (as N)	25
Phenols	0.14
Manganese	675
Suspended Solids	-
pH	8.8-11.3
4 Benzene	0.011
23 Chloroform	0.023
55 Naphthalene	0.015
85 Tetrachloroethylene	0.055
86 Toluene	0.013
115 Arsenic	1.750
117 Beryllium	#
119 Chromium	#
121 Cyanide (Total)	-
122 Lead	#
127 Thallium	#
128 Zinc	4.349

- : Calculation results in a negative value.
: Values are qualified resulting in insufficient data to complete the necessary calculations.

IRONMAKING SUBCATEGORY

SECTION VI

WASTEWATER POLLUTANTS

Introduction

This section describes the pollutants which the Agency determined are characteristic of ironmaking process wastes, the rationale for their selection and the sources of these pollutants. First, a list of pollutants considered to be characteristic of ironmaking operations was developed based upon data gathered during the original guidelines survey and from the DCP responses. The Agency confirmed that the initial list of pollutants was appropriate and added other pollutants by reviewing analytical data gathered during the toxic pollutant survey.

Conventional Pollutants

The originally promulgated BPT effluent limitations established controls for suspended solids and pH. The Agency selected suspended solids because of the substantial quantities of particulates found in the ironmaking process wastewaters.

The Agency selected pH as a limited pollutant because it is a measure of the acidity or alkalinity of wastewater discharges. In addition to its direct adverse environmental impacts, extremes in pH can cause other problems, e.g., aggravating the adverse effects of other pollutants such as ammonia-N and cyanide, facilitating corrosion, and provoking process and wastewater treatment system malfunctions. The pH of ironmaking process wastewaters was found to be typically in the neutral to slightly alkaline range.

Nonconventional, Nontoxic Pollutants

In both iron and ferromanganese blast furnace operations, ammonia is present in the furnace exit gases and, as a result, is also present in furnace process wastewaters. Ammonia is present as a result of the various nitrogen compounds which are driven out of the coke charge during blast furnace operations. Fluoride is present in ironmaking process wastewaters as a result of the various fluoride compounds, primarily calcium fluoride, present in the limestone charged to the furnace. The presence of manganese in ferromanganese blast furnace wastewaters is related to the type of ore used in ferromanganese furnace operations. Limitations for ammonia-N were included in the previous regulation.

Toxic Pollutants

Cyanide is generated as a result of the reaction of nitrogen in the blast air, with carbon from the coke charge, in the reducing atmosphere of the furnace. Larger quantities of cyanide are generated at the higher temperatures associated with ferromanganese furnaces. Phenolic compounds are driven out of the coke charge during blast furnace operation. These toxic pollutants were included in the group of pollutants limited in the originally promulgated regulation.

The Agency also considered other toxic pollutants found in blast furnace wastewaters. The Agency determined the pollutants existing in these process wastewaters on the basis of responses to the DCPs, and analyses performed during the screening phase of the project. Table VI-1 presents these pollutants.

The Agency evaluated relevant data regarding these pollutants and calculated net concentration values (reflecting the pollutant pickup per pass through the process as described in Section V) for each pollutant detected in the raw process wastewaters. The Agency established effluent limitations on a gross basis only (see Section V). Those pollutants found at an average net concentration of less than 0.010 mg/l were excluded from further consideration. A list of pollutants, including the conventional and nonconventional pollutants, detected in the raw process wastewaters at net concentrations of 0.010 mg/l or greater are presented in Table VI-2.

The toxic metal pollutants detected in the process wastewaters originate in the raw materials (primarily the ores and sinter) charged to the furnaces. These pollutants are present in the blast furnace exist gases and contaminate the process wastewaters during scrubbing operations. The predominant toxic metal pollutant in ironmaking process wastewaters is zinc. For details pertaining to the selection of pollutants considered for limitation, refer to Sections X through XIII.

Although several toxic organic pollutants are included in the list of pollutants presented in Table VI-1, Table VI-2 does not include all of these pollutants. The Agency excluded certain toxic organic pollutants from Table VI-2 (i.e., phthalates) because it believes that those pollutants are artifacts (i.e., resulting from sampling and laboratory procedures), which are unrelated to blast furnace operations. The presence of the remaining toxic organic pollutants is attributable to the raw materials charged (primarily, the coke charge). These pollutants will be controlled by the limitation on phenols.

Other pollutants (i.e., calcium, chloride) are present at substantial levels in the process wastewaters, but are not included in the list of selected pollutants since they are nontoxic in nature and difficult to remove. Treatment of these pollutants in wastewater discharges is not commonly practiced in any industry.

TABLE VI-1

TOXIC POLLUTANTS KNOWN TO BE PRESENT

Iron Blast Furnaces	
121	Cyanide
	Phenols
4	Benzene
9	Hexachlorobenzene
31	2,4-dichlorophenol
34	2,4-dimethylphenol
39	Fluoranthene
65	Phenol
73	Benzo(a)pyrene
76	Chrysene
84	Pyrene
85	Tetrachloroethylene
86	Toluene
114	Antimony
115	Arsenic
118	Cadmium
119	Chromium
120	Copper
122	Lead
123	Mercury
124	Nickel
125	Selenium
126	Silver
127	Thallium
128	Zinc

Ferromanganese Blast Furnaces	
121	Cyanide
	Phenols
4	Benzene
23	Chloroform
55	Naphthalene
65	Phenol
85	Tetrachloroethylene
86	Toluene
114	Antimony
115	Arsenic
117	Beryllium
118	Cadmium
119	Chromium
120	Copper
122	Lead
124	Nickel
125	Selenium
126	Silver
127	Thallium
128	Zinc

TABLE VI-2

SELECTED POLLUTANTS

	Iron Blast Furnaces
	Ammonia (as N)
121	Cyanide (Total)
	Phenols
	Fluoride
	Suspended Solids
	pH
9	Hexachlorobenzene
31	2,4-Dichlorophenol
34	2,4-Dimethylphenol
39	Fluoranthene
65	Phenol
73	Benzo(a)pyrene
76	Chrysene
84	Pyrene
114	Antimony
115	Arsenic
118	Cadmium
119	Chromium
120	Copper
122	Lead
124	Nickel
125	Selenium
126	Silver
128	Zinc

	Ferromanganese Blast Furnaces
	Ammonia (as N)
121	Cyanide (Total)
	Phenols
	Manganese
	Suspended Solids
	pH
4	Benzene
23	Chloroform
55	Naphthalene
85	Tetrachloroethylene
86	Toluene
115	Arsenic
117	Beryllium
119	Chromium
122	Lead
127	Thallium
128	Zinc

IRONMAKING SUBCATEGORY

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Introduction

A review of the control and treatment technologies currently in use or available for use in the ironmaking subcategory provided the basis for the selection and development of the BPT, BAT, NSPS, PSES and PSNS alternative treatment systems. This review involved the compilation of DCP, D-DCP, and plant visit data to identify those treatment components and systems currently in use. Treatment capabilities, either demonstrated in this or in other subcategories (refer to Volume I), were used by the Agency in evaluating the various model wastewater treatment technologies. However, only well demonstrated technologies were used to develop effluent limitations and standards for ironmaking operations.

This section also presents the raw wastewater and treated effluent analytical data from sampled plants, pilot plant studies, and the effluent analytical data provided by the industry through D-DCP responses. In addition, this section describes treatment systems at each of the sampled plants.

Control and Treatment Technologies

As noted earlier, ironmaking wastewaters result primarily from furnace top gas cleaning and cooling. Other wastewater sources may be included; however, these sources comprise only a minor portion of the total waste load. Although the typical ironmaking wastewater treatment systems were initially designed for the removal of particulate matter only, other pollutants, (i.e., ammonia, cyanide and phenols) are present in these wastewaters and require treatment. Following is a summary of actual treatment practices as determined by the Agency through plant visits and DCP responses (refer to the Summary Tables III-1 and III-2).

a. The initial step in the treatment of ironmaking wastewaters is the removal of suspended solids. Approximately 90 percent of the plants use a thickener (or similar gravity sedimentation component) to remove suspended solids from process wastewaters. The technology also removes other pollutants which are entrained in the suspended solids (e.g., the toxic metals).

b. The slurry from the bottom of the thickener is dewatered by various devices. Most plants (50%) employ vacuum filters for this purpose.

c. In order to improve solids removal performance in the thickeners, various coagulant aids, such as polymers (used in about 43 percent of the plants) and ferric chloride, are added to the wastewater stream at the thickener inlet. These coagulant aids enhance solids removal by aiding in the formation of larger, more readily settleable particles. This technology also results in a certain degree of toxic pollutant removal as pollutants entrained in the solids are removed.

d. At five plants, the thickener/clarifier overflow is reused elsewhere. One method of reuse involves the mixing of the thickener effluent with incoming fresh water for use in various process or cooling applications throughout the plant, as well as for makeup to the blast furnace gas cleaning and cooling systems. In these operations, the cooling water is discharged at a point somewhat distant from the plant intake. Reuse of the effluent in the plant water system results in the dilution of the wastewater.

e. In order to conserve water and to reduce effluent waste loads, many plants (54%) employ systems in which a large portion of the process wastewater is recycled. A recent survey by EPA indicates that recycle is now practiced or will shortly be practiced at about 90% of the plants. In the basic recycle system, the thickener effluent is recirculated through a cooling tower to the gas cleaning and cooling operations. The wastewater discharge in these instances consists of a blowdown (of the thickener effluent or of the cooling tower effluent) from the treatment and recycle system. As discussed previously, the solids which settle in the thickener are dewatered by a vacuum filter and the filtrate is returned to the thickener influent. In treatment and recycle operations, flocculation, sedimentation and recycle provide the only significant means of pollutant load reduction, although some oxidation or air stripping may occur in the cooling tower.

f. Several plants employ chlorination treatment primarily as a means of reducing cyanide and phenol levels. One plant provides for the alkaline chlorination of its thickener influent which is then discharged without recycle. In another plant, the thickener effluent is recycled after passage through a cyanide destruction system (alkaline chlorination). Both of these plants were sampled during this study, and the latter plant exhibited the capability to significantly reduce the levels of ammonia, cyanide, and phenol.

g. At least one plant uses a bio-oxidation system for the purpose of reducing cyanide levels.

h. The blowdowns from two recycle systems are discharged to POTWs.

i. The blowdowns from recirculation systems at five plants are used to quench slag or coke, or are evaporated in BOF hoods. This treatment arrangement, under careful control, can eliminate discharges of pollutants into the navigable waters.

Control and Treatment Technologies for BAT, NSPS, PSES and PSNS

Several toxic pollutants were found in the treated effluents of the sampled plants at concentrations greater than 0.5 mg/l. Because of high discharge levels, the Agency is proposing BAT limitations and NSPS, PSES, and PSNS for these toxic pollutants. The proposed effluent limitations are based upon the application of various advanced levels of treatment. A description of the treatment technologies considered by the Agency for BAT, NSPS, PSES and PSNS is set out below.

Filtration

Filtration is a common and effective method of removing suspended solids and those pollutants (particularly the toxic metals) which are entrained in these solids. Filtration can be used as the last major component in a treatment system or may be used to provide pretreatment prior to another component (such as an activated carbon system). Generally, the filter bed is comprised of one or more filter media (e.g., sand, anthracite, garnet) and a variety of filtration systems are available (flat bed, deep bed, pressure or gravity). As noted above, filtration can be used to reduce the discharge of certain toxic pollutants (the toxic metals). However, other toxic pollutants, such as cyanide and phenols, will not, for all practical purposes, be removed from the process wastewaters by this technology. Filtration is used in a wide variety of steel industry applications, including three central treatment facilities (one was sampled) which treat ironmaking wastewaters.

Toxic Metals Removal Using Sulfide Precipitation

Systems incorporating the addition of a sulfide compound have been shown to be capable of reducing effluent toxic metals concentrations substantially below the levels achieved in lime flocculation and precipitation systems. Some of the toxic metals which can effectively be precipitated with sulfide are zinc, copper, nickel, lead, and silver. The increased removal efficiencies can be attributed to the comparative solubilities of metal sulfides and metal hydroxides. In general, the metal sulfides are less soluble than the respective metal hydroxides. However, an excess of sulfide in a treated effluent can result in objectionable odor problems. A decrease in wastewater pH will aggravate this problem, and if wastewater treatment pH control problems result in even a slightly acidic pH, operating personnel can be affected. One method of controlling the presence of excess sulfide in the treated effluent involves feeding an iron sulfide slurry. Ferrous sulfide will not readily dissociate in the waste stream, ensuring that the free sulfide level is kept below objectionable levels. However, the affinities of the other metals in the waste stream for sulfide are greater than that of iron, which causes other metal sulfide precipitates to form preferentially to iron sulfide. Once the sulfide requirements of the other metal precipitates are satisfied, sulfide remains as a ferrous precipitate and the excess iron from the sulfide is precipitated as a hydroxide. With the use of filtration following sulfide addition, significant toxic metals load reductions can be achieved.

Alkaline Chlorination

Certain nonconventional and toxic pollutants are amenable to treatment by oxidation reactions. Because it has been demonstrated within the ironmaking subcategory, the Agency considered alkaline chlorination as an alternative treatment technology at the BAT, NSPS, PSES and PSNS levels of treatment. Alkaline chlorination involves the addition of chlorine (a strong oxidizing agent) to process wastewaters which already are, or which have been adjusted, to an alkaline pH. Chlorine addition is typically accomplished by the eduction of the gas into a pumped wastewater sidestream which is returned to the treatment process, or by the addition of a liquid such as sodium hypochlorite to the treatment process. The oxidation reduction potential (ORP) of the wastewaters being treated is measured during treatment to monitor and control the alkaline chlorination treatment process.

Alkaline chlorination is used primarily to destroy cyanides. However, it also serves to remove ammonia (N), phenols, and other toxic organics. The end-products of the cyanide destruction reactions are CO_2 and N_2. The end-products of the oxidation of ammonia are principally N_2 and H_2O, while the basic end-product of phenols oxidation is CO_2.

With regard to the formation of chlorinated hydrocarbons during alkaline chlorination, pilot plant studies at plant 0860B indicate that chlorinated hydrocarbon formation is negligible, as shown in Table VII-8. Data from additional pilot plant studies also show negligible chlorinated hydrocarbon formation, while low levels of brominated compounds were generated.

Dechlorination

To minimize the potential toxicity of wastewaters which have undergone chlorination, the Agency considered dechlorination as a treatment method to reduce total residual chlorine levels in the treated discharge. Existing wastewater treatment practices in this subcategory are uniformly indadequate for dechlorination purposes. This technology is widely practiced in the electric power generation and electroplating industries and can be used for blast furnace and sintering wastewaters as well. As one of the final treatment steps, dechlorination is generally effective on wastewaters generated by various sources. The Agency therefore believes that it will be equally effective when applied to ironmaking wastewaters. Reducing agents, such as sulfites or sulfur dioxide, are added to the chlorinated effluent in sufficient quantities to react with the excess residual chlorine, thereby forming nontoxic chlorides. This technology is considered as part of a total alkaline chlorination system.

Removal of Organics With Activated Carbon

Adsorption with activated carbon has long been used in a variety of applications for the removal of organic pollutants from wastewaters. One of the more frequent uses of this technology is the reduction of COD and BOD concentrations in the effluent from sanitary treatment systems. This technology is also used to remove organic pollutants in the wastewaters of various industrial operations such as petroleum refining, organic chemicals, and cokemaking. It should be noted that several toxic organic pollutants found in ironmaking wastewaters are also found in cokemaking wastewaters. This can be attributed to the use of large quantities of coke in the ironmaking process.

Operational guidelines for the use of activated carbon specify that when combined wastewater streams are being treated or where the wastewater to be treated has significant turbidity, clarification or filtration is necessary to achieve optimum treatment efficiency. The use of chemical precipitation and diatomaceous earth filtration may be necessary to achieve the clarity required for the removal of the toxic organic pollutants which are present at low levels. The need for the control of suspended solids in the wastewater to be treated by activated carbon is also indicated because particulates in water can adsorb organic pollutants, and then release these organics after passing through the carbon bed.

Laboratory tests performed on single compound systems indicate that processing with activated carbon may achieve residual levels on the order of 1 microgram per liter for many of the organic compounds on the list of toxic pollutants. The Agency believes that the following compounds (among others) should respond well to adsorption: carbon tetrachloride, chlorinated benzenes, chlorinated ethanes, chlorinated phenols, haloethers, phenols, nitrophenols, DDT and metabolites, pesticides, polynuclear aromatics and PCBs.

The pH of the wastewater to be treated must be controlled within the range 6-8 to minimize dissociation of both acid and basic compounds. Generally, normal pH variations within the neutral range will not significantly affect the operation of activated carbon systems. In addition, it may be impractical, as well as extremely expensive to have two carbon adsorption systems in series, one operating in a low and the other in a high pH range.

Plant Visit Data

Table VII-1 provides a legend for the various control and treatment technology abbreviations used in tables throughout this report. Table VII-2 presents a summary of raw wastewater and effluent data for the iron blast furnaces visited in conjunction with the original guidelines survey. Table VII-3 presents a summary of all iron blast furnace raw wastewater data collected during the toxic pollutant survey, and Table VII-4 presents a summary of the respective effluent data. Table VII-5 presents a summary of raw wastewater and effluent analytical data from a ferromanganese blast furnace visited during the original guidelines survey. Table VII-6 presents a summary of ferromanganese raw wastewater and effluent analytical data obtained during the toxic pollutant survey.

Table VII-7 presents a summary of effluent analytical data provided in the D-DCPs. Table VII-8 presents a summary of pilot plant data from plant 0860B. Table VII-9 presents a summary of long-term effluent data for the recycle system blowdown at plant 0860B.

Plant Visits

Iron Blast Furnaces

Following are summaries of the eight iron blast furnaces visited during the original guidelines and toxic pollutant surveys. Plant schematics are found at the end of this section.

Plant L - Figure VII-1

Blast furnace gas cleaning system wastewaters are combined with sinter plant wastewaters and treated by sedimentation in a thickener, alkaline chlorination, filtration and recycle with the blowdown being discharged to a receiving stream.

Plant M - Figure VII-2

Blast furnace gas cleaning system wastewaters are treated by sedimentation in a thickener, evaporative cooling and recycle. A portion of the thickener overflow is discharged to a POTW while most is passed through a cooling tower and recycled.

Plant N - Figure VII-3

Blast furnace gas cleaning system wastewaters are treated by sedimentation in a thickener, evaporative cooling and recycle. The blowdown is completely evaporated by slag and coke quenching, and BOF hood sprays. There is no wastewater discharge to a receiving stream.

Plant O - Figure VII-4

Blast furnace gas cleaning system wastewaters are treated by sedimentation in a thickener, evaporative cooling, and recycle. An electrostatic precipitator is used following the venturi scrubbers and gas cooler. The blowdown is completely evaporated by slag and coke quenching. There is no wastewater discharge to a receiving stream.

Plant 021 (Confidential)

Wastewaters from individual blast furnace scrubbing systems are combined and treated by sedimentation in a thickener, acid addition for pH adjustment, evaporative cooling and recycle. A portion of the recycle water is blowndown. The blowdown is combined with other plant wastewaters and treated further at a central treatment facility.

Plant 026 - Figure VII-5

Blast furnace gas cleaning system wastewaters are combined with slag pit quench wastewaters and treated by pH adjustment with acid, coagulation with polymer, sedimentation in a thickener, evaporative cooling and recycle. A portion of the recycle water is blowndown to a central treatment facility which receives wastewaters from various segments of an integrated mill.

Plant 027 - Figure VII-6

Blast furnace gas cleaning, sintering, and dekishing wastewaters are combined in a central treatment facility which includes sedimentation in a thickener, and alkaline chlorination. The effluent from the once-through treatment system is discharged to a receiving stream.

Plant 028 - Figure VII-7

Blast furnace gas cleaning system wastewaters are treated by aeration, pH adjustment with lime, chlorination, coagulation with polymer, sedimentation in a thickener, evaporative cooling and recycle. A portion of the recycle water is blowndown to a POTW.

Ferromanganese Blast Furnace

Ferromanganese blast furnace operations are similar to iron blast furnace operations as top gases are cleaned using the same types of wet scrubbers. However, major differences between iron and ferromanganese furnaces in raw materials, and furnace operating temperatures result in differences in process wastewater quality. Ferromanganese furnaces produce higher levels of cyanide and manganese.

Information on ferromanganese furnaces is scarce because, historically only a few furnaces in the U.S. have produced ferromanganese. In fact, at the time of this study only one furnace was operational. Recently this remaining furnace was shut down and is not expected to renew operations in the forseeable future.

During the course of the original guidelines and toxic pollutant surveys, this particular ferromanganese operation was surveyed twice. The operation was sampled a second time because its wastewater treatment system had been upgraded since the first visit. The result of this upgrading was that the operation ceased discharging pollutants to the receiving stream. Approximately 90 gal/ton of wastewater left the system with the filter cake which was transported to a landfill for disposal.

A brief description of this plant under the two different treatment approaches is provided below:

Plant Q - Figure VII - 8

Venturi scrubber wastewater treatment included sedimentation in a thickener and complete recycle to the scrubbers. Gas cooler wastewaters were discharged to a receiving stream without treatment.

Plant 025 - Figure VII - 9

Venturi scrubber wastewater treatment included sedimentation in a thickener and complete recycle to the scrubbers. Gas cooler wastewater treatment included sedimentation in a thickener and complete recycle to the coolers. This plant had no wastewater discharge to a receiving stream.

TABLE VII-1

OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

Symbols

A. **Operating Modes**

1. OT Once-Through

2. Rt,s,n Recycle, where t = type waste
s = stream recycled
n = % recycled

t: U = Untreated
T = Treated

	s	n
P	Process Wastewater	% of raw waste flow
F	Flume Only	% of raw waste flow
S	Flume and Sprays	% of raw waste flow
FC	Final Cooler	% of FC flow
BC	Barometric Cond.	% of BC flow
VS	Abs. Vent Scrub.	% of VS flow
FH	Fume Hood Scrub.	% of FH flow

3. REt,n Reuse, where t = type
n = % of raw waste flow

t: U = before treatment
T = after treatment

4. BDn Blowdown, where n = discharge as % of raw waste flow

B. **Control Technology**

10. DI Deionization

11. SR Spray/Fog Rinse

12. CC Countercurrent Rinse

13. DR Drag-out Recovery

C. **Disposal Methods**

20. H Haul Off-Site

21. DW Deep Well Injection

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 2

C. Disposal Methods (cont.)

22.	Qt,d	Coke Quenching, where t = type d = discharge as % of makeup t: DW = Dirty Water CW = Clean Water
23.	EME	Evaporation, Multiple Effect
24.	ES	Evaporation on Slag
25.	EVC	Evaporation, Vapor Compression Distillation

D. Treatment Technology

30.	SC	Segregated Collection
31.	E	Equalization/Blending
32.	Scr	Screening
33.	OB	Oil Collecting Baffle
34.	SS	Surface Skimming (oil, etc.)
35.	PSP	Primary Scale Pit
36.	SSP	Secondary Scale Pit
37.	EB	Emulsion Breaking
38.	A	Acidification
39.	AO	Air Oxidation
40.	GF	Gas Flotation
41.	M	Mixing
42.	Nt	Neutralization, where t = type t: L = Lime C = Caustic A = Acid W = Wastes O = Other, footnote

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 3

D. Treatment Technology (cont.)

43.	FLt	Flocculation, where t = type t: L = Lime A = Alum P = Polymer M = Magnetic O = Other, footnote
44.	CY	Cyclone/Centrifuge/Classifier
44a.	DT	Drag Tank
45.	CL	Clarifier
46.	T	Thickener
47.	TP	Tube/Plate Settler
48.	SLn	Settling Lagoon, where n = days of retention time
49.	BL	Bottom Liner
50.	VF	Vacuum Filtration (of e.g., CL, T, or TP underflows)
51.	Ft,m,h	Filtration, where t = type m = media h = head

t	m	h
D = Deep Bed	S = Sand	G = Gravity
F = Flat Bed	O = Other, footnote	P = Pressure

52.	CLt	Chlorination, where t = type t: A = Alkaline B = Breakpoint
53.	CO	Chemical Oxidation (other than CLA or CLB)

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 4

D. Treatment Technology (cont.)

54.	BOt	Biological Oxidation, where t = type t: An = Activated Sludge n = No. of Stages T = Trickling Filter B = Biodisc O = Other, footnote
55.	CR	Chemical Reduction (e.g., chromium)
56.	DP	Dephenolizer
57.	ASt	Ammonia Stripping, where t = type t: F = Free L = Lime C = Caustic
58.	APt	Ammonia Product, where t = type t: S = Sulfate N = Nitric Acid A = Anhydrous P = Phosphate H = Hydroxide O = Other, footnote
59.	DSt	Desulfurization, where t = type t: Q = Qualifying N = Nonqualifying
60.	CT	Cooling Tower
61.	AR	Acid Regeneration
62.	AU	Acid Recovery and Reuse
63.	ACt	Activated Carbon, where t = type t: P = Powdered G = Granular
64.	IX	Ion Exchange
65.	RO	Reverse Osmosis
66.	D	Distillation

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 5

D. Treatment Technology (cont.)

67.	AAl	Activated Alumina
68.	OZ	Ozonation
69.	UV	Ultraviolet Radiation
70.	CNTt,n	Central Treatment, where t = type n = process flow as % of total flow t: 1 = Same Subcats. 2 = Similar Subcats. 3 = Synergistic Subcats. 4 = Cooling Water 5 = Incompatible Subcats.
71.	On	Other, where n = Footnote number
72.	SB	Settling Basin
73.	AE	Aeration
74.	PS	Precipitation with Sulfide

TABLE VII-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
IRON MAKING BLAST FURNACES

Raw Wastewaters

Reference No.	0946A		0396A		0448A		0060F		Average	
Plant Code:	L		M		N		O			
Sample Point(s)	1		1		1		1			
Flow, gal/ton(1)	5400		2057		3350		3123		3482	
	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb
Ammonia (as N)	1.91	0.0430	63.2	0.541	227	3.17	85.5	1.11	94.4	1.22
121 Cyanide (T)	1.43	0.0322	16.9	0.145	18.5	0.258	9.67	0.126	11.6	0.140
Phenols	0.132	0.00297	2.77	0.0237	0.564	0.00787	0.095	0.00124	0.890	0.00894
Fluoride	0.64	0.0144	23	0.197	12.7	0.177	17.7	0.230	13.5	0.155
Suspended Solids	81	1.82	693	5.94	346	4.83	1209	15.7	582	7.07
pH	6.6		7.1-8.3		6.6-6.7		7.4-7.5		6.6-8.3	

Effluents

Sample Point(s)	(3/3+7) 6		2+3		2		4	
Flow, gal/ton(1)	3391		123		101		104	
C&TT	T,CLA,SS,Filters, RTP 37		T,CT, RTP 94		T,CT,SL,ES, RTP 97		T,FLP,CT, RTP 97,ES	
	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lb/1000 lb
Ammonia (as N)	0.806	0.0186	Unable to determine accurately, as a major portion of the system is discharge is a sludge blowdown to the sinter plant		225	0.0942	82.2	0.0356
121 Cyanide (T)	0.005	0.000173			17.3	0.00724	10.8	0.00468
Phenols	0.014	0.000363			0.035	0.000015	0.010	0.000004
Fluoride	0.68	0.0116			10.7	0.00448	22	0.00954
Suspended Solids	3	0.0372			39	0.0163	46	0.0199
pH	7.6				6.7-8.1		8.0	

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(1) Presented in English units for convenience of industry and government accustomed to working with English units. Multiply by 4.17 to convert to metric units.

NOTE: For a definition of C&TT codes, refer to Table VII-1.

TABLE VII-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES

Raw Wastewaters

Reference No.	0196A		0112D		0432A		0684H		0112	0684F	0860H	Average	
Plant Codes	021		026		027		028		030	029	024	2012	
Sample Points	B		G+K-I-M		C		B		-	-	-		
Flow, gal/ton	1,111		1,567		3,091		2,277		N/A	N/A	N/A		
	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	mg/l	mg/l	mg/l	lbs/1000 lbs
Ammonia (as N)	62.5	*	57.9	0.378	18	0.232	25	0.237	159	NA	23.6	57.7	0.282
121 Cyanide (T)	41.5	*	0.054	0.000352	12.1	0.156	0.301	0.00285	43.4	NA	2.15	16.6	0.0531
Phenols	7.41	*	0.080	0.000522	3.02	0.0389	2.50	0.0237	1.52	NA	0.083	2.44	0.0210
Fluoride	152	*	15.6	0.102	6.7	0.0862	9	0.0853	12	NA	76	45.2	0.0912
Suspended Solids	3560	*	512	3.34	1,643	21.1	1,640	15.6	263	NA	429	1341	13.2
pH (Units)	8.4-8.9	*	6.4-7.1		9.4	-	10.2	-	7.1	NA	8.3	6.4-10.2	-
9 Hexachlorobenzene	0.155	*	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.022	ND
31 2,4-Dichlorophenol	ND	*	ND	ND	ND	ND	0.240	0.00228	ND	ND	ND	0.034	0.000076
34 2,4-Dimethyl phenol	ND	*	0.001	0.000007	0.053	0.000682	0.003	0.000028	<0.010	<0.010	ND	0.011	0.000239
39 Fluoranthene	16.105	*	0.004	0.000026	0.082	0.00106	ND	ND	0.022	<0.010	<0.010	2.32	0.000045
65 Phenol	4.000	*	ND	ND	0.637	0.00820	0.247	0.00234	0.130	ND	ND	0.716	0.00351
73 Benzo(a) pyrene	14.198	*	0.001	0.000007	0.007	0.000090	ND	ND	<0.010	<0.010	<0.010	2.03	0.000033
76 Chrysene	0.462	*	0.016	0.000104	0.007	0.000090	ND	ND	0.010	<0.010	<0.010	0.074	0.000065
84 Pyrene	15.140	*	0.007	0.000046	0.053	0.000682	ND	ND	0.018	<0.010	<0.010	2.18	0.000244
114 Antimony	NA	*	NA	NA	0.037	0.000476	NA	NA	<0.001	0.010	0.008	0.014	0.000476
115 Arsenic	NA	*	NA	NA	0.046	0.000592	NA	NA	0.491	0.015	0.046	0.150	0.000592
118 Cadmium	0.040	*	0.010	0.000065	0.200	0.00257	0.153	0.00145	0.107	0.011	0.025	0.078	0.00136
119 Chromium	0.090	*	0.070	0.000457	0.480	0.00618	0.633	0.00600	0.869	0.045	0.121	0.33	0.00421
120 Copper	0.30	*	0.012	0.000078	0.120	0.00154	1.167	0.0111	0.997	0.059	0.085	0.39	0.00424
122 Lead	55.0	*	1.05	0.00685	4.667	0.0601	23.33	0.221	-	0.508	0.895	14.24	0.0960
124 Nickel	0.20	*	0.021	0.000137	#	#	1.200	0.0114	2.448	0.192	0.597	0.93	ISD
125 Selenium	NA	*	NA	NA	0.063	0.000811	NA	NA	0.035	<0.003	0.001	0.026	0.000811
126 Silver	0.060	*	0.012	0.000078	#	#	0.073	0.000692	0.047	0.005	0.005	0.034	ISD
128 Zinc	85.0	*	5.93	0.0387	20.0	0.257	30.00	0.284	-	1.059	1.822	24.0	0.193

TABLE VII-3
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES
PAGE 2

ND : Not detected
N/A: Not available
NA : Not analyzed

* : Confidential data
ISD : Insufficient data to complete evaluation
# : Values for determinations are qualified

NOTES: FLFC - Flocculation with Ferric Chloride
For a definition of C&TT Codes, see Table VII-1.

TABLE VII-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES

Effluents

	Referenced No.	0196A		0112D		0432A		0684H		0'12		0684F	0860H
	Plant Code	021		026		027		028		030		029	024
	Sample Points	D+E		(G+K-I-M/G+K)N		C/(B+C+D+E) F		C					
	Flow, gal/ton	87		73		3091		188		76		N/A	N/A
	C&TT	CL, NA, VF, CT, RTP-93		T, FLP, VF, NA, CT, RTP-97		PSP, FLP, T, CLA, OT		A, CLA, FLP, CL, CT, FLFC, NA, RTP-92		T, FLP, NA, VF, CT, RTP-Unk		PSP, Scr, FLP, FLO(1), CL, SS, NA, VF, CT, RTP-Unk	PSP, Scr, FLP, CL T, VF, CT, RTP-Unk, ES
		mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	mg/l
	Ammonia (as N)	43.0	*	43.7	0.0133	20	ISD	16	0.0125	138	0.0437	NA	25.1
121	Cyanide (T)	28.4	*	0.049	0.000015	1.11	0.0153	0.227	0.000178	21.0	0.00666	NA	1.700
	Phenols	7.37	*	0.029	0.000009	2.85	0.0392	2.00	0.00157	0.207	0.000066	NA	0.019
	Fluoride	147	*	16.6	0.00505	3.2	0.0415	7.9	0.00618	8.6	0.00272	NA	76
	Suspended Solids	101	*	70.5	0.0215	38	0.431	44	0.0344	55	0.0174	NA	61
	pH (Units)	8.6-10.8	*	7.3-7.5	-	10.1-10.9	-	8.2-8.8	-	7.2-7.5	-	NA	8.3
9	Hexachlorobenzene	ND	*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31	2,4-Dichlorophenol	0.007	*	ND	ND	ND	ND	0.044	0.000034	ND	ND	ND	ND
34	2,4-Dimethylphenol	ND	*	0.004	0.000001	0.163	0.00223	ND	ND	ND	ND	ND	<0.010
39	Fluoranthene	0.180	*	0.003	0.000001	0.007	0.000096	0.023	0.000018	<0.010	<0.000003	<0.010	<0.010
65	Phenol	1.846	*	0.004	0.000001	0.630	0.00865	0.563	0.000440	0.011	0.000003	<0.010	ND
73	Benzo(a) pyrene	0.008	*	ND	ND	0.003	0.000039	ND	ND	<0.010	<0.000003	ND	<0.010
76	Chrysene	0.054	*	0.003	0.000001	0.007	0.000090	ND	ND	<0.010	<0.000003	<0.010	<0.010
84	Pyrene	0.041	*	ND	ND	0.007	0.000096	0.012	0.000009	<0.010	<0.000003	<0.010	<0.010
114	Antimony	NA	*	NA	NA	0.015	0.000198	NA	NA	0.002	~0.0	<0.005	0.025
115	Arsenic	NA	*	NA	NA	0.006	0.000081	NA	NA	0.005	0.000002	0.004	0.029
118	Cadmium	0.006	*	0.010	0.000003	#	ISD	0.010	0.000008	0.017	0.000005	<0.001	0.008
119	Chromium	0.052	*	0.025	0.000008	#	ISD	0.009	0.000007	0.080	0.000025	0.025	0.082
120	Copper	0.19	*	0.016	0.000005	0.026	ISD	0.030	0.000023	0.123	0.000039	0.007	0.032
122	Lead	2.11	*	0.098	0.000030	0.079	ISD	0.083	0.000065	1.413	0.000447	<0.001	0.238
124	Nickel	0.10	*	0.010	0.000003	#	#	0.060	0.000047	0.843	0.000267	0.111	0.280
125	Selenium	NA	*	NA	NA	0.004	0.000054	NA	NA	0.001	~0.0	<0.003	0.001
126	Silver	0.023	*	0.010	0.000003	#	#	0.005	0.000004	0.013	0.000004	0.005	0.005
128	Zinc	27.5	*	1.45	0.000441	0.935	0.0129	0.333	0.000261	-	-	0.074	0.380

ND : Not detected
N/A: Not available
NA : Not analyzed

* : Confidential data
ISD: Insufficient data to complete evaluation
: Values for determinations are qualified

NOTES: FLFC - Flocculation with Ferric Chloride
For a definition of C&TT Codes, see Table VII-1.

TABLE VII-5

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
FERROMANGANESE BLAST FURNACE

Raw Wastewaters	Scrubber		Gas Cooler	
Plant Codes	0112C		0112C	
	Q		Q	
Sample Point(s)	2		5	
Flow, gal/ton(1)	2,233		5,705	
	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs
Ammonia (as N)	155	1.44	137	3.26
121 Cyanide (T)	3,886	36.1	105	2.50
Phenols	19.1	0.178	0.471	0.0112
Manganese	2,960	27.5	6.05	0.144
Suspended Solids		17,260	160	57
pH	12.2		8.7	

Effluent	Scrubber		Gas Cooler	
Sample Point(s)			No treatment provided	
Flow, gal/ton				
C&TT	100% recycle with thickener and vacuum filter			
			mg/l	lbs/1000 lbs
Ammonia (as N)			Same as Raw	
121 Cyanide (T)				
Phenols				
Manganese				
Suspended Solids				
pH				

---

(1) Presented in English units for convenience of industry and government accustomed to working with English units. Conversion to metric can be accomplished by multiplying by 4.17.

TABLE VII-6

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
FERROMANGANESE BLAST FURNACE

	Raw Wastewaters		Effluent
Reference Code	0112C		0112C
Plant Code	025		025
Sample Point(s)	B+D		-
Flow, gal/ton	11,540		0
C&TT	-		Clarifier, Thickener Cooling Tower
	mg/l	lbs/1000 lbs	
Ammonia (as N)	711	34.2	
121 Cyanide (T)	692	33.3	
Phenols	6.5	0.312	
Manganese	503	24.2	
Suspended Solids	4,160	200	
pH	8.8-11.3		
4 Benzene	0.021	0.00102	
23 Chloroform	0.163	0.00784	
55 Naphthalene	0.039	0.00185	
85 Tetrachloroethylene		0.064	0.00309
86 Toluene	0.017	0.000807	
115 Arsenic	7.67	0.369	
117 Beryllium	ISD	ISD	
119 Chromium	ISD	ISD	
122 Lead	ISD	ISD	
127 Thallium	ISD	ISD	
128 Zinc	30.4	1.46	

ISD: Insufficient data to complete evaluation

TABLE VII-7

SUMMARY OF D-DCP ANALYTICAL DATA
IRON MAKING BLAST FURNACES

(All concentrations expressed in mg/l)

Plant Code		0112				0384A - Plant 2				0384A - Plant 3			
C&TT		Polymer, Neutralization with acid, thickener, cooling tower, vacuum filter				Lagoon, thickener, neutralization with acid, cooling tower				Lagoon, thickener, neutralization with acid, polymer, cooling tower			
		No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation
	Flow, gal/min	531	370	573	114								
	Temperature, °F												
	Ammonia	49	80.4	201.2	43.3	296	37	438	27	389	51	190	32
121	Cyanide (T)	532	3.93	35	6.08	221	0.86	4.7	1.09	381	0.23	5.6	1.52
	Phenols	49	3.04	9.17	2.51	389	0.005	0.072	0.008	388	0.069	2.8	0.298
	Fluoride												
	Suspended Solids	89	36.5	251.2	49.6	389	80	1331	79	387	27	157	16
	pH, units	501	6.85	8.2	-	390	8.0	8.4	-	390	7.7	8.4	-
	Dissolved Solids												
9	Hexachlorobenzene					1	<0.01	-	-				
31	2,4-Dichlorophenol					1	<0.01	-	-				
34	2,4-Dimethylphenol					1	<0.01	-	-				
39	Fluoranthene					1	<0.01	-	-				
65	Phenol					1	<0.01	-	-				
73	Benzo(a)pyrene					1	<0.01	-	-				
76	Chrysene					1	<0.01	-	-				
84	Pyrene					1	<0.01	-	-				
114	Antimony					9	<0.01	-	-				
115	Arsenic					9	<0.01	-	-				
118	Cadmium					9	<0.01	-	-				
119	Chromium					9	<0.01	<0.1	-				
120	Copper					1	<0.01	-	-				
122	Lead					9	<0.01	0.8	-				
124	Nickel					9	<0.01	<0.2	-				
125	Selenium					1	<0.01	-	-				
126	Silver					9	0	-	-				
128	Zinc					1	<0.01	-	-				

TABLE VII-7
SUMMARY OF D-DCP ANALYTICAL DATA
IRON MAKING BLAST FURNACES
PAGE 2

(All concentrations expressed in mg/l)

Plant Code	0684F				0684H				0868A				0920B			
C&TT	Scale pit, screening, polymer, ferric chloride, clarifier, skimmer, neutralization with acid, cooling tower vacuum filter				Aeration, lime, polymer, chlorination, clarifier, vacuum filter, cooling tower				Polymer, thickener, lagoon, cooling tower				Scale pit, polymer, clarifier, Neutralization with acid, thickener, cooling tower			
	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation
Flow, gal/min	2077	1103	2979	527	609	486	560	46								
Temperature, °F	466	84.5	118	11.3												
Ammonia	123	25.2	124	17.3	76	14.9	62	10.9					57	114	142	10
121 Cyanide (T)	123	0.635	4.79	0.854	76	0.957	13.39	209					10	54	110	30
Phenols	124	0.068	0.75	0.115									13	31	74	18
Fluoride	6	5.73	9.42	2.98	76	6.52	15	3.21					13	0.5	3.5	0.9
Suspended Solids	1817	35.7	492	37.4	76	20.5	74	17.6	119	14	49	9.4	52	120	550	85
pH, units	476	7.53	9.6	-	76	8.56	9.3	-	119	8.0	9.0	-	62	6.9	8.2	-
Dissolved Solids	1819	1050	1910	204									53	3600	8200	1600
118 Cadmium	7	0.008	0.01	0.001												
119 Chromium	7	0.028	0.049	0.012												
120 Copper	7	0.032	0.058	0.016												
122 Lead	7	0.065	0.103	0.027												
124 Nickel	7	0.062	0.078	0.015												
128 Zinc	7	0.161	0.36	0.111					54	1.28	6.25	1.27				

TABLE VII-8

PLANT 0860B PILOT PLANT TREATABILITY STUDY
TOXIC ORGANIC POLLUTANT ANALYTICAL DATA[(1)]

	Plant Recycle System Blowdown		Pilot Treatment System Influent (Hotwell Water Influent	Chlorinator Effluent	Carbon Column Effluent
	1/23-26/80	2/20-22/80	3/18/80	11/28/79	11/28/79
4 Benzene	ND	ND	ND	0.002	0.002
23 Chloroform	ND	ND	ND	0.003	0.003
44 Methylene Chloride	ND	ND	ND	0.030	0.030
47 Bromoform	ND	ND	ND	0.035	<0.001
48 Dichlorobromomethane	ND	ND	ND	<0.001	0.003
51 Chlorodibromomethane	ND	ND	ND	0.027	<0.001
66 Bis(2-ethylhexyl)phthalate	0.096	0.030	ND	ND	ND
68 Di-n-butyl phthalate	0.002	ND	ND	ND	ND
70 Diethyl phthalate	0.001	ND	ND	ND	ND
86 Toluene	ND	ND	ND	<0.001	<0.001

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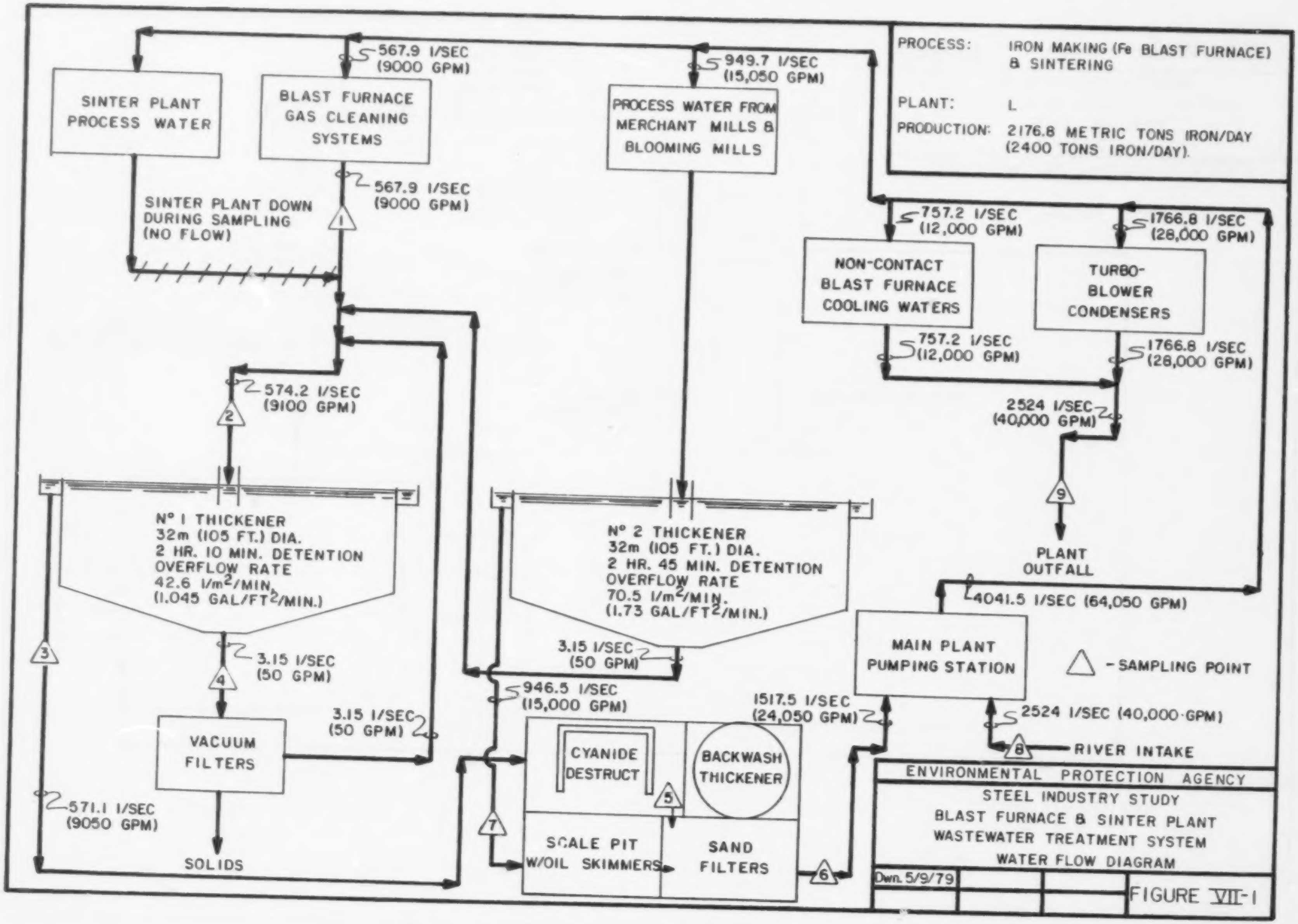
(1) All values are expressed in mg/l. All toxic organic pollutants not included in the above list were not detected during the GC/MS analyses.

ND: Not detected

TABLE VII-9

PLANT 0860B BLAST FURNACE RECYCLE SYSTEM BLOWDOWN EFFLUENT QUALITY

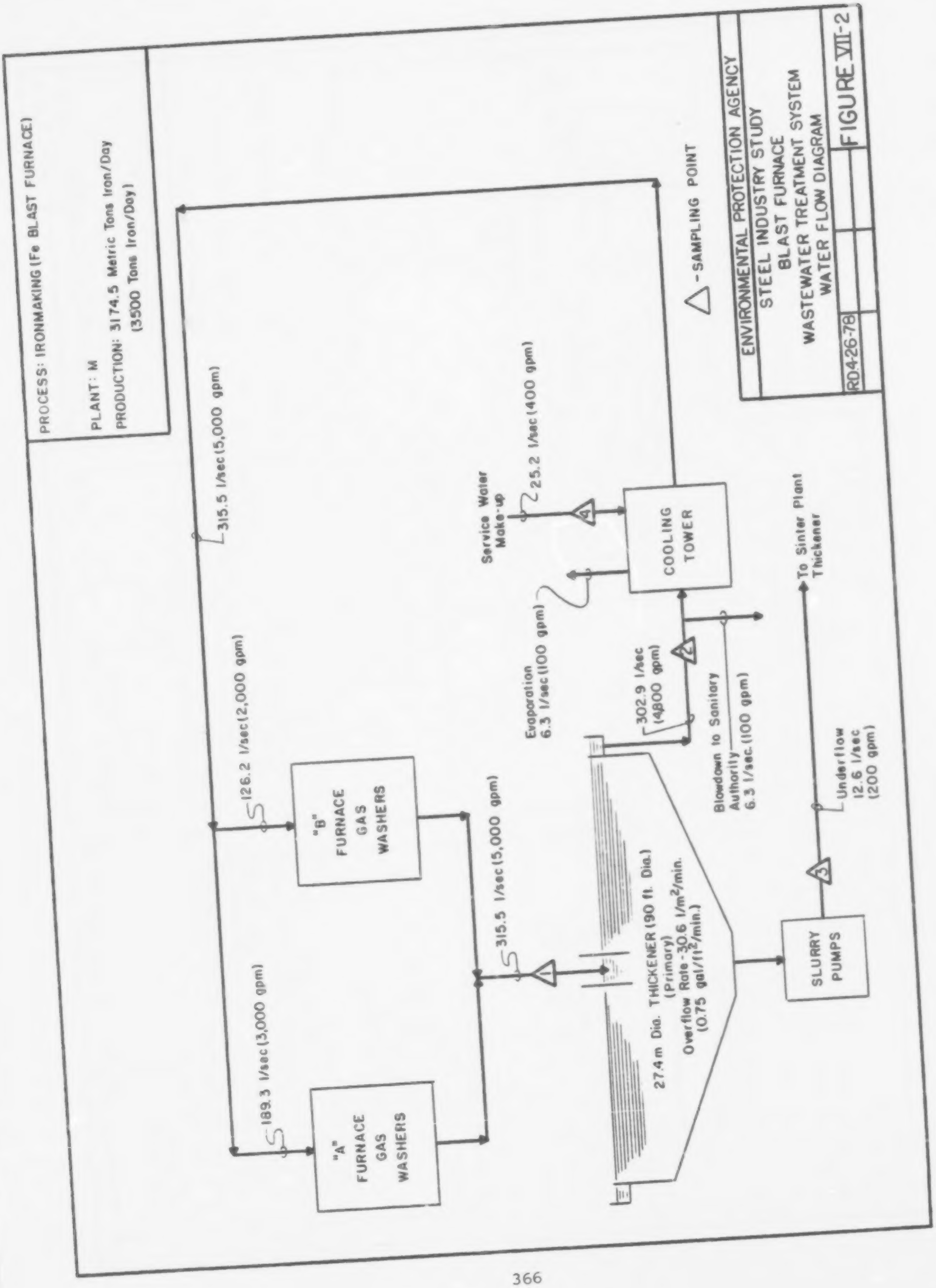
Pollutants	No. of Analyses	Average Value	Maximum Value	Minimum Value	Standard Deviation
Suspended Solids	102	8.88	20.0	1.0	4.32
Ammonia (as N)	102	53.1	98.1	4.7	15.4
121 Cyanide (Total)	102	1.85	6.24	0.01	1.57
Phenols	102	0.037	0.559	0.001	0.075
128 Zinc	18	0.36	0.65	0.10	0.21

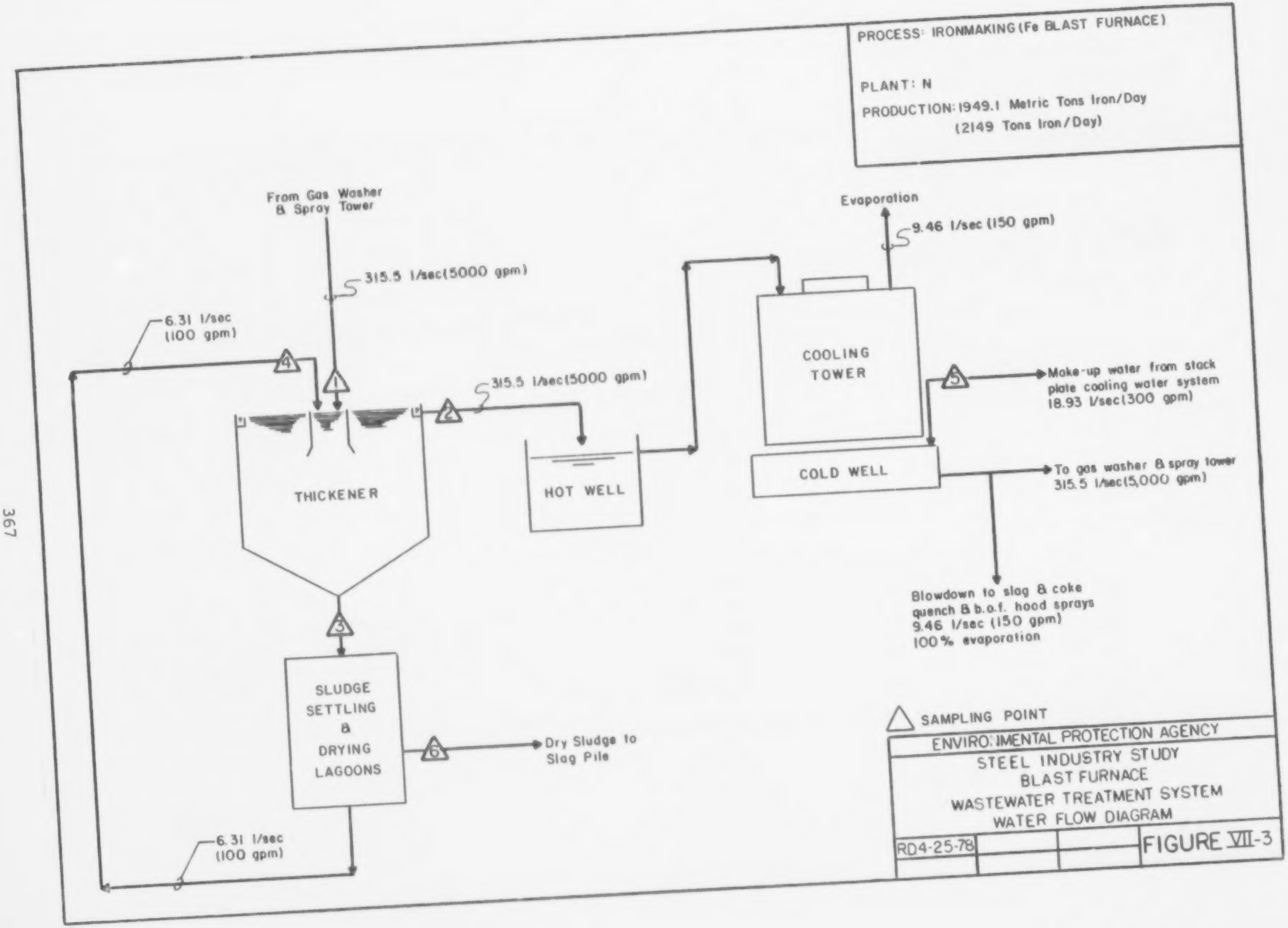

PROCESS: IRON MAKING (Fe BLAST FURNACE) & SINTERING
PLANT: L
PRODUCTION: 2176.8 METRIC TONS IRON/DAY (2400 TONS IRON/DAY).
SINTER PLANT PROCESS WATER
BLAST FURNACE GAS CLEANING SYSTEMS
567.9 l/SEC (9000 GPM)
567.9 l/SEC (9000 GPM)
SINTER PLANT DOWN DURING SAMPLING (NO FLOW)
1
PROCESS WATER FROM MERCHANT MILLS & BLOOMING MILLS
949.7 l/SEC (15,050 GPM)
757.2 l/SEC (12,000 GPM)
NON-CONTACT BLAST FURNACE COOLING WATERS
757.2 l/SEC (12,000 GPM)
1766.8 l/SEC (28,000 GPM)
TURBO-BLOWER CONDENSERS
1766.8 l/SEC (28,000 GPM)
2524 l/SEC (40,000 GPM)
9
PLANT OUTFALL
4041.5 l/SEC (64,050 GPM)
574.2 l/SEC (9100 GPM)
2
N° 1 THICKENER
32m (105 FT.) DIA.
2 HR. 10 MIN. DETENTION
OVERFLOW RATE
42.6 l/m²/MIN.
(1.045 GAL/FT²/MIN.)
3
3.15 l/SEC (50 GPM)
4
VACUUM FILTERS
3.15 l/SEC (50 GPM)
571.1 l/SEC (9050 GPM)
SOLIDS
N° 2 THICKENER
32m (105 FT.) DIA.
2 HR. 45 MIN. DETENTION
OVERFLOW RATE
70.5 l/m²/MIN.
(1.73 GAL/FT²/MIN.)
3.15 l/SEC (50 GPM)
946.5 l/SEC (15,000 GPM)
CYANIDE DESTRUCT
5
BACKWASH THICKENER
7
SCALE PIT W/OIL SKIMMERS
SAND FILTERS
6
1517.5 l/SEC (24,050 GPM)
MAIN PLANT PUMPING STATION
△ - SAMPLING POINT
2524 l/SEC (40,000 GPM)
8
RIVER INTAKE
Dwn. 5/9/79

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE & SINTER PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-1


PROCESS: IRONMAKING (Fe BLAST FURNACE)
PLANT: M
PRODUCTION: 3174.5 Metric Tons Iron/Day
(3500 Tons Iron/Day)
315.5 l/sec (5,000 gpm)
126.2 l/sec (2,000 gpm)
189.3 l/sec (3,000 gpm)
"A" FURNACE GAS WASHERS
"B" FURNACE GAS WASHERS
315.5 l/sec (5,000 gpm)
1
27.4m Dia. THICKENER (90 ft. Dia.)
(Primary)
Overflow Rate - 30.6 l/m²/min.
(0.75 gal/ft²/min.)
SLURRY PUMPS
3
Underflow
12.6 l/sec
(200 gpm)
To Sinter Plant Thickener
302.9 l/sec
(4800 gpm)
2
Evaporation
6.3 l/sec (100 gpm)
Blowdown to Sanitary Authority
6.3 l/sec. (100 gpm)
COOLING TOWER
4
Service Water Make-up
25.2 l/sec (400 gpm)
△ - SAMPLING POINT
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD4-26-78
FIGURE VII-2

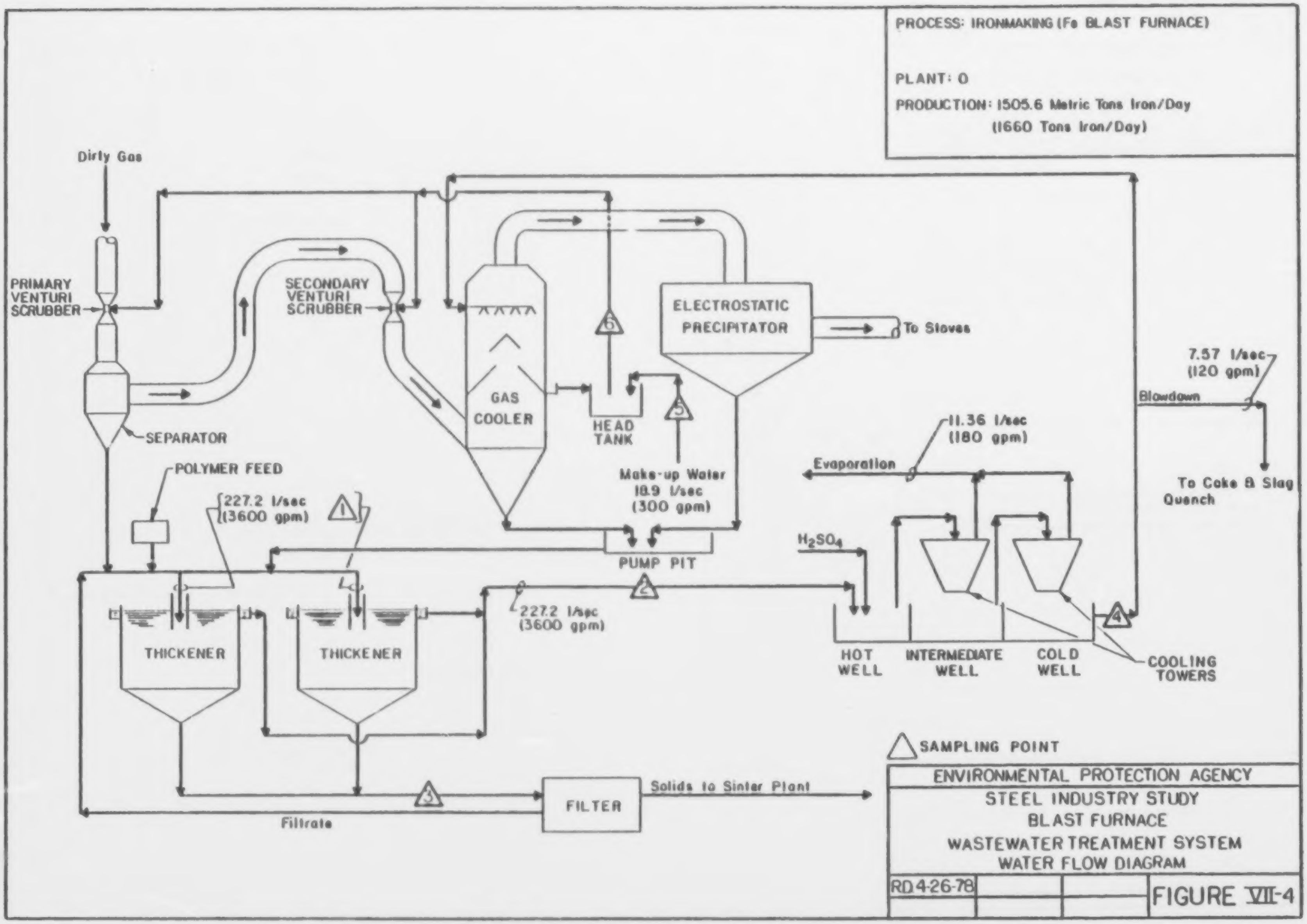

PROCESS: IRONMAKING (Fe BLAST FURNACE)

PLANT: N

PRODUCTION: 1949.1 Metric Tons Iron/Day
(2149 Tons Iron/Day)

From Gas Washer & Spray Tower
315.5 l/sec (5000 gpm)
6.31 l/sec (100 gpm)
4
1
2
315.5 l/sec (5000 gpm)
THICKENER
HOT WELL
3
SLUDGE SETTLING & DRYING LAGOONS
6
Dry Sludge to Slag Pile
6.31 l/sec (100 gpm)
Evaporation
9.46 l/sec (150 gpm)
COOLING TOWER
COLD WELL
5
Make-up water from stack plate cooling water system 18.93 l/sec (300 gpm)
To gas washer & spray tower 315.5 l/sec (5,000 gpm)
Blowdown to slag & coke quench & b.o.f. hood sprays 9.46 l/sec (150 gpm) 100% evaporation
△ SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD4-25-78
FIGURE VII-3


PROCESS: IRONMAKING (Fe BLAST FURNACE)

PLANT: O

PRODUCTION: 1505.6 Metric Tons Iron/Day
(1660 Tons Iron/Day)

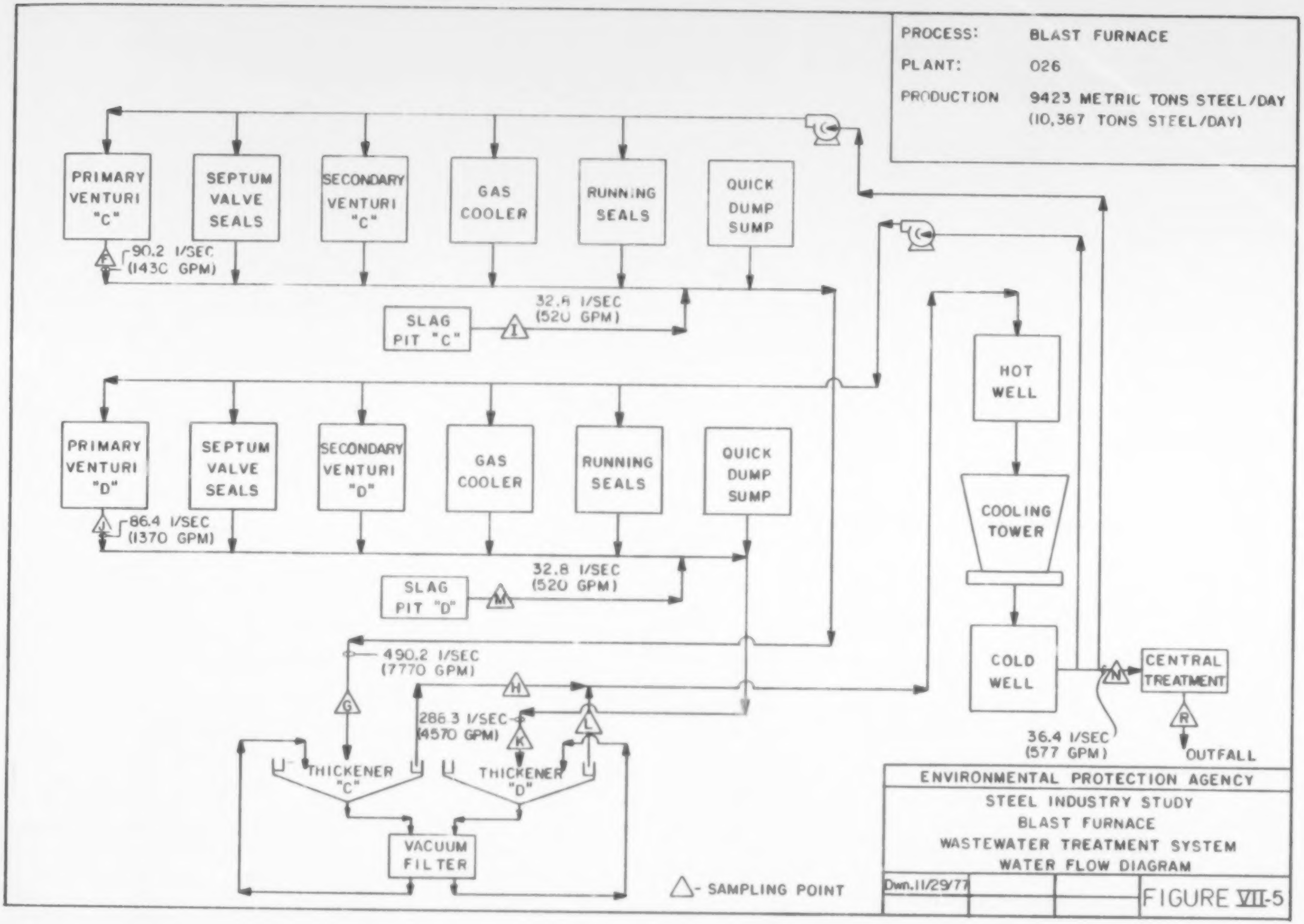
Dirty Gas
PRIMARY VENTURI SCRUBBER
SEPARATOR
SECONDARY VENTURI SCRUBBER
GAS COOLER
HEAD TANK
ELECTROSTATIC PRECIPITATOR
To Stoves
6
5
Make-up Water 18.9 l/sec (300 gpm)
PUMP PIT
2
POLYMER FEED
227.2 l/sec (3600 gpm)
1
THICKENER
THICKENER
227.2 l/sec (3600 gpm)
3
FILTER
Solids to Sinter Plant
Filtrate
H_2SO_4
Evaporation
11.36 l/sec (180 gpm)
HOT WELL
INTERMEDIATE WELL
COLD WELL
COOLING TOWERS
4
Blowdown
7.57 l/sec (120 gpm)
To Coke & Slag Quench
SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

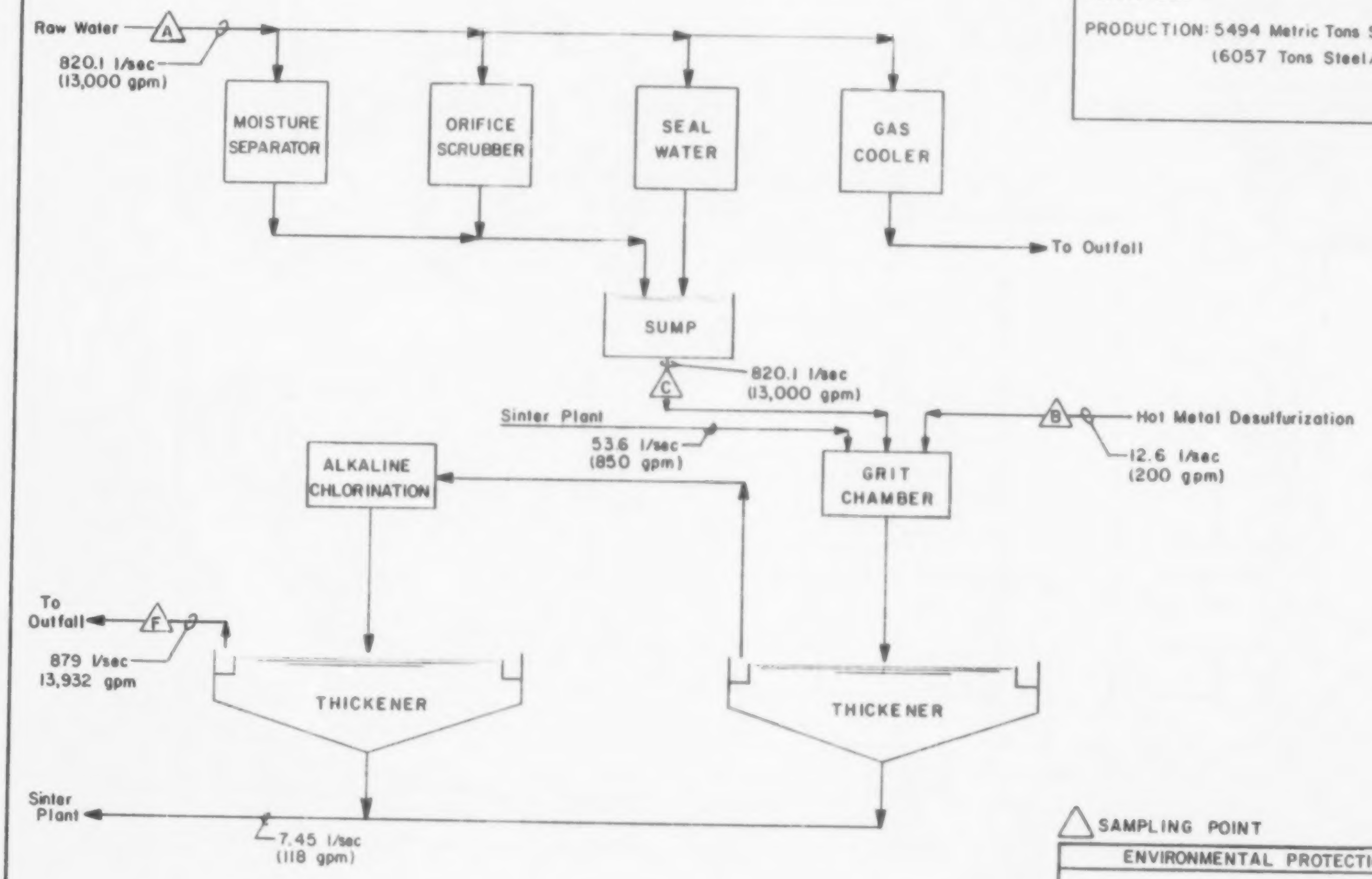
RD 4-26-78

FIGURE VII-4


PROCESS: BLAST FURNACE
PLANT: 026
PRODUCTION 9423 METRIC TONS STEEL/DAY
(10,367 TONS STEEL/DAY)
PRIMARY VENTURI "C"
SEPTUM VALVE SEALS
SECONDARY VENTURI "C"
GAS COOLER
RUNNING SEALS
QUICK DUMP SUMP
F
90.2 l/SEC
(1430 GPM)
SLAG PIT "C"
I
32.8 l/SEC
(520 GPM)
PRIMARY VENTURI "D"
SEPTUM VALVE SEALS
SECONDARY VENTURI "D"
GAS COOLER
RUNNING SEALS
QUICK DUMP SUMP
J
86.4 l/SEC
(1370 GPM)
SLAG PIT "D"
M
32.8 l/SEC
(520 GPM)
HOT WELL
COOLING TOWER
COLD WELL
N
CENTRAL TREATMENT
R
OUTFALL
36.4 l/SEC
(577 GPM)
490.2 l/SEC
(7770 GPM)
G
H
286.3 l/SEC
(4570 GPM)
K
L
THICKENER "C"
THICKENER "D"
VACUUM FILTER
△- SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
Dwn. 11/29/77
FIGURE VII-5

PROCESS: BLAST FURNACE
PLANT: 027
PRODUCTION: 5494 Metric Tons Steel/Day
(6057 Tons Steel/Day)


Raw Water
A
820.1 l/sec
(13,000 gpm)
MOISTURE SEPARATOR
ORIFICE SCRUBBER
SEAL WATER
GAS COOLER
To Outfall
SUMP
C
820.1 l/sec
(13,000 gpm)
Sinter Plant
53.6 l/sec
(850 gpm)
B
Hot Metal Desulfurization
12.6 l/sec
(200 gpm)
ALKALINE CHLORINATION
GRIT CHAMBER
To Outfall
F
879 l/sec
13,932 gpm
THICKENER
THICKENER
Sinter Plant
7.45 l/sec
(118 gpm)

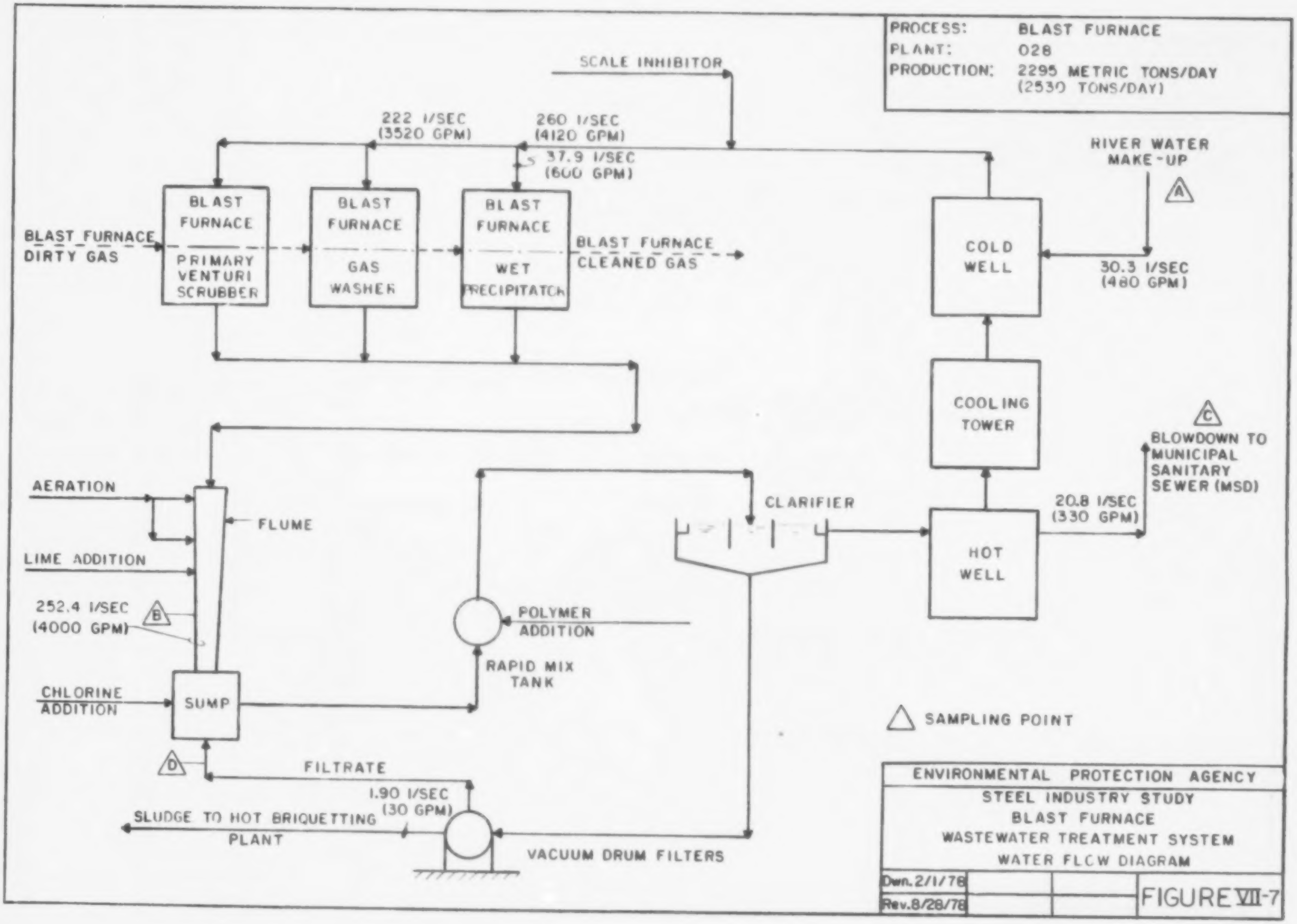
△ SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn. 12/2/77

FIGURE VII-6

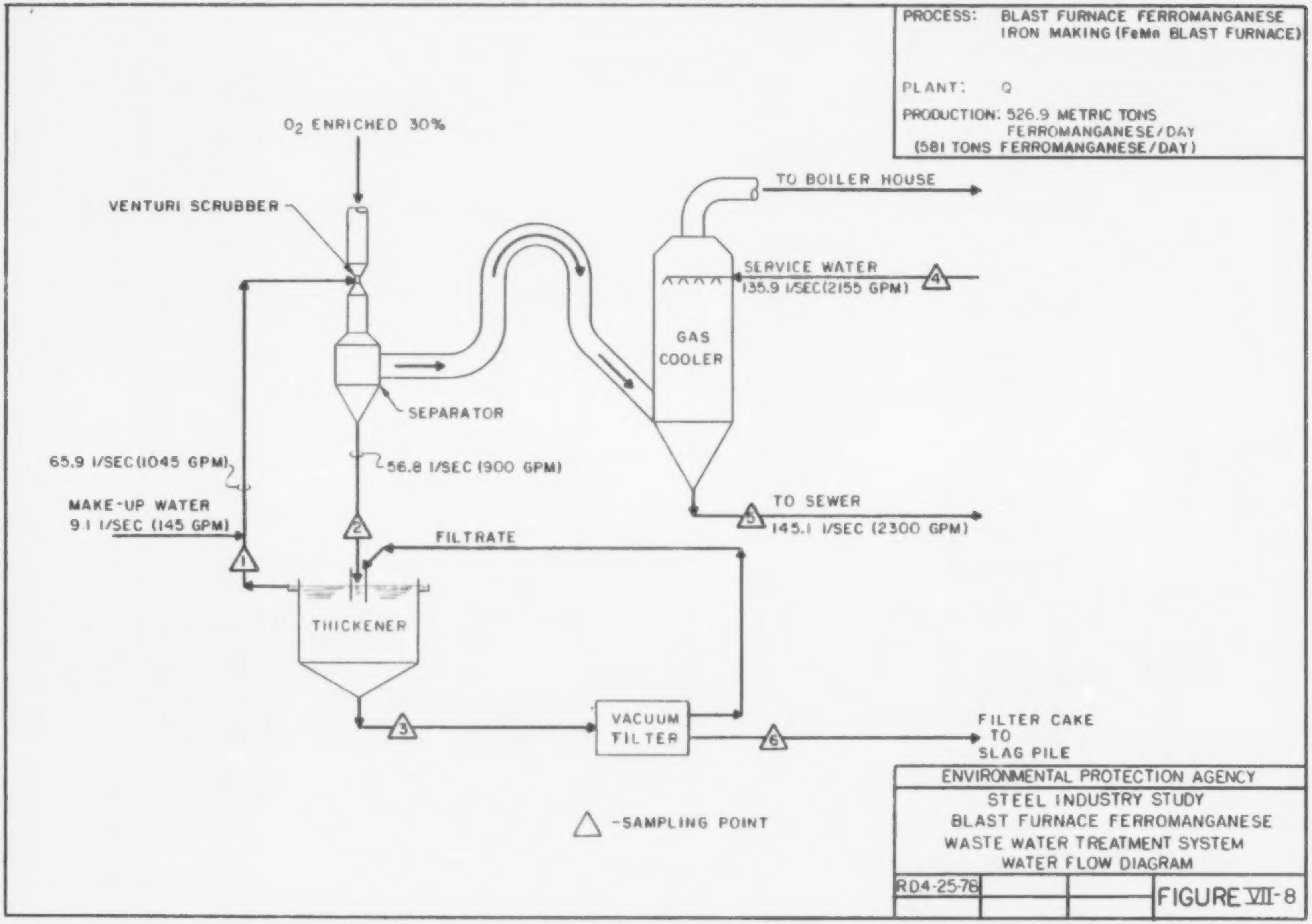

SCALE INHIBITOR
222 l/SEC
(3520 GPM)
260 l/SEC
(4120 GPM)
37.9 l/SEC
(600 GPM)
RIVER WATER
MAKE-UP
A
BLAST FURNACE
DIRTY GAS
BLAST
FURNACE
PRIMARY
VENTURI
SCRUBBER
BLAST
FURNACE
GAS
WASHER
BLAST
FURNACE
WET
PRECIPITATOR
BLAST FURNACE
CLEANED GAS
COLD
WELL
30.3 l/SEC
(480 GPM)
COOLING
TOWER
C
BLOWDOWN TO
MUNICIPAL
SANITARY
SEWER (MSD)
AERATION
FLUME
CLARIFIER
20.8 l/SEC
(330 GPM)
HOT
WELL
LIME ADDITION
252.4 l/SEC
(4000 GPM)
B
POLYMER
ADDITION
RAPID MIX
TANK
CHLORINE
ADDITION
SUMP
SAMPLING POINT
D
FILTRATE
1.90 l/SEC
(30 GPM)
SLUDGE TO HOT BRIQUETTING
PLANT
VACUUM DRUM FILTERS

PROCESS: BLAST FURNACE
PLANT: 028
PRODUCTION: 2295 METRIC TONS/DAY
(2530 TONS/DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn. 2/1/78
Rev. 8/28/78

FIGURE VII-7


O2 ENRICHED 30%
VENTURI SCRUBBER
SEPARATOR
GAS COOLER
TO BOILER HOUSE
SERVICE WATER
135.9 l/SEC(2155 GPM)
4
65.9 l/SEC(1045 GPM)
56.8 l/SEC (900 GPM)
MAKE-UP WATER
9.1 l/SEC (145 GPM)
1
2
TO SEWER
5
145.1 l/SEC (2300 GPM)
FILTRATE
THICKENER
3
VACUUM FILTER
6
FILTER CAKE
TO
SLAG PILE
△ -SAMPLING POINT

PROCESS: BLAST FURNACE FERROMANGANESE
IRON MAKING (FeMn BLAST FURNACE)

PLANT: Q

PRODUCTION: 526.9 METRIC TONS
FERROMANGANESE/DAY
(581 TONS FERROMANGANESE/DAY)

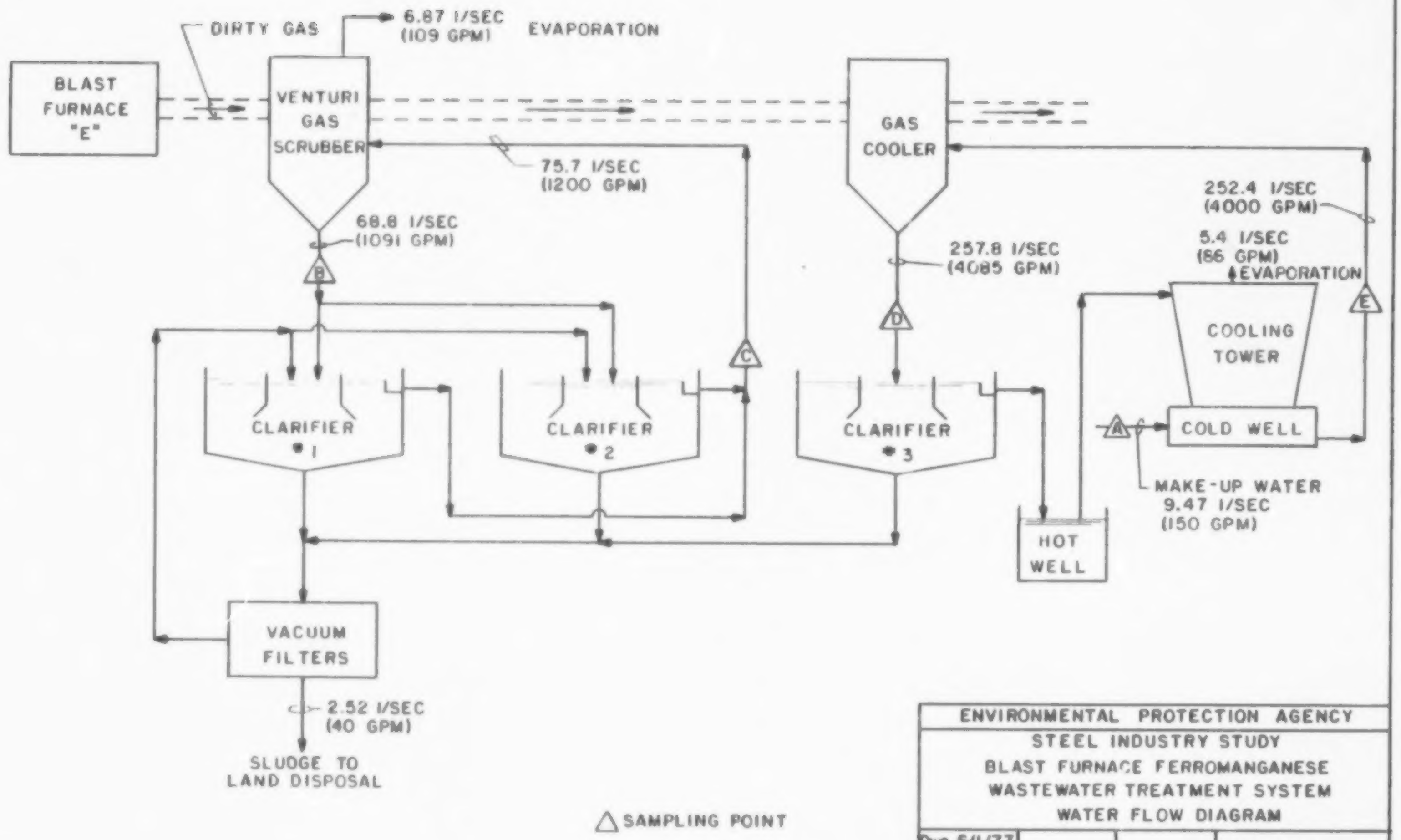
ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE FERROMANGANESE
WASTE WATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

R04-25-78

FIGURE VII-8

PROCESS: BLAST FURNACE (FERROMANGANESE)
PLANT: 025
PRODUCTION: 586 METRIC TONS/DAY
(646 TONS/DAY)


DIRTY GAS
6.87 l/SEC
(109 GPM)
EVAPORATION
BLAST FURNACE "E"
VENTURI GAS SCRUBBER
75.7 l/SEC
(1200 GPM)
68.8 l/SEC
(1091 GPM)
B
C
GAS COOLER
257.8 l/SEC
(4085 GPM)
D
252.4 l/SEC
(4000 GPM)
5.4 l/SEC
(86 GPM)
EVAPORATION
COOLING TOWER
E
COLD WELL
A
MAKE-UP WATER
9.47 l/SEC
(150 GPM)
CLARIFIER #1
CLARIFIER #2
CLARIFIER #3
HOT WELL
VACUUM FILTERS
2.52 l/SEC
(40 GPM)
SLUDGE TO LAND DISPOSAL
△ SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE FERROMANGANESE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn. 6/1/77
Rev. 8/29/78

FIGURE VII-9

IRONMAKING SUBCATEGORY

SECTION VIII

COST, ENERGY AND NONWATER QUALITY ASPECTS

Introduction

This section presents the incremental costs which the Agency estimates the industry will incur in meeting the proposed limitations and standards. These costs were determined on the basis of the appropriate model wastewater treatment system. The analysis includes a consideration of: energy requirements; nonwater quality impacts; and, the techniques, magnitude and costs associated with the application of the BPT, BAT, BCT, NSPS, PSES and PSNS model wastewater treatment technologies. This section also addresses the BCT cost comparison test and the consumptive use of water as it relates to the ironmaking subcategory.

Actual Costs Incurred by the Plants Sampled or Solicited for this Study

Tables VIII-1 and VIII-2 present the water pollution control costs reported by dischargers which were sampled during the original or toxic pollutant surveys or which responded to the D-DCPs. The reported costs have been updated to July 1978 dollars. In most instances, standard cost of capital and depreciation factors were applied to the reported costs to determine those portions of the annual costs of operation. In the remaining instances, these costs were provided by the industry. It should be noted that the amortization costs reported by the industry (cost of capital and depreciation) are similar to the amortization costs which would have been determined by applying the factors noted on the tables.

As shown below, the capital cost data provided by the industry were compared with the Agency's estimates of required expenditures for eleven plants. The Agency's estimates are based upon the model treatment system size factored to the size of each of the eleven plants.

Plant No.	Actual Costs	Estimated Costs
0060	2,963,000	6,464,000
*0060F	6,020,000	4,845,000
*0112	7,384,000	13,346,000
*0112D	8,217,000	13,350,000
0384A	20,896,000	21,819,000
*0396A	1,664,000	5,435,000
0432A	9,290,000	8,907,000
0684F	22,507,000	16,239,000
*0868A	4,707,000	7,071,000
*0920B	5,172,000	7,923,000
0946A	6,492,000	3,573,000
TOTAL	100,559,000	115,010,000

*Plants which exhibited effluent flows equal to or less than the BPT treatment model effluent flow of 125 gal/ton.

NOTE: The costs reported by Plant 0684F include expenditures for screening, settling tanks, and other items which were not included in the Agency's estimated costs.

Of the Agency's estimated plant costs, 67 percent are greater than the actual costs reported by industry. More important, however, is the comparison of the total actual and the total estimated costs, as this comparison reflects the overall accuracy of the Agency's estimate of the costs of compliance for the entire ironmaking subcategory. As the reported cost total is 87 percent of the estimated total, the Agency concluded that its estimates fairly reflect the actual cost of compliance with its proposed limitations and these estimates are sufficiently generous to account for site-specific and other incidental costs (such as retrofit) which might be incurred by industry. A more detailed discussion of this issue is contained in Section VII of Volume I. The reported cost total for those plants with effluent flows equal to or less than the BPT treatment model effluent flow is only 64 percent of the estimated cost total for these plants. This comparison demonstrates that plants may achieve the proposed limitations while employing treatment systems installed at less cost than estimated on the basis of the model treatment system.

In addition, the Agency compared its estimated costs for its model treatment system with a cost estimate prepared by an engineering firm for the same model treatment system. This firm estimated the costs for the second BAT treatment alternative in the October 1979 draft development document and supplied its estimate as a comment regarding the draft development document. A comparison of the flow basis and estimated costs for the treatment model and company model (both systems utilize the same model size) follows:

	EPA Estimate	Engineering Firm Estimate
Flow	50 gal/ton	100 gal/ton
Capital	$2.49 million	$3.94 million

While the Agency's estimate appears to be substantially less than the engineering firm's estimate, when the Agency's estimate is adjusted on the basis of flow to conform to the engineering firm's model (100 gal/ton), the Agency's estimated cost increases to $3.78 million. This is within 4.1 percent of this engineering firm's unsolicited estimate thereby providing a further check on the Agency's costing methodology. The general discussion regarding this issue in Volume I provides further verification of the accuracy of the Agency's estimates of treatment model costs.

Control and Treatment Technology in Use or Available to Blast Furnace Operations

The variations in technology in use or available for use to treat blast furnace wastewaters are presented in Table VIII-3. It should be noted that a discharger is not required to use any of the model technology components, as any method of treatment which achieves the effluent limitations is adequate. In addition to listing the treatment methods available, these tables describe for each method:

1. Status and reliability
2. Problems and limitations
3. Implementation time
4. Land requirements
5. Environmental impacts other than water
6. Solid waste generation

These tables also provide a summary of the treatment components which comprise the BPT model and BAT alternative treatment systems for ironmaking operations. Later in this section, the Agency sets out the estimated costs for the individual components of these treatment systems.

Estimated Cost for the Installation of Pollution Control Technologies

A. Costs Required to Achieve the Proposed BPT Limitations

The first step in determining the estimated costs of compliance involved the development of a treatment model upon which the cost estimates could be based. The model size (tons/day) was developed on the basis of the average production capacity for all blast furnace sites. This averaging method was used so that the concept of central treatment for the wastewaters from several blast furnaces at one site could be more accurately represented. The Agency developed the applied flow for the model treatment system on the same basis.

The components and effluent flows discussed in Sections IX and X were then incorporated to complete the development of the treatment model. Subsequently, unit costs for each treatment model component were developed. Table VIII-4 presents the estimated investment and annual expenditures associated with the application of BPT treatment technologies to the treatment model. The capital requirements needed to achieve the BPT level of treatment for the ironmaking subcategory were determined by applying the treatment component model costs, adjusted for size, to each blast furnace site. These estimates pertain to only iron blast furnaces as no ferromanganese blast furnaces are currently in operation. As noted previously, ferromanganese blast furnace production has been only a minor segment of all ironmaking operations. In order to assess the economic impact of the various effluent limitations upon the industry, the Agency estimated the expenditures required to bring those plants from current treatment levels to the BPT level from which BAT technology can be installed. Table VIII-5 presents a summary of the estimated expenditures required to achieve the proposed BPT limitations for all iron blast furnaces. The estimated capital requirement of BPT for this subcategory is $122.3 million, while the estimated annual cost is $95.28 million. A recent survey of the industry by EPA (June 1980), indicates that only about $22 million of BPT technology has not been spent or committed.

B. Costs Required to Achieve the Proposed BAT Limitations

The Agency considered five alternative treatment systems for the ironmaking subcategory. The descriptions, rationale, and additional details for these alternatives are provided in Section X. The Agency's estimate of the additional investment and annual expenditures to be incurred in applying each of the BAT alternative treatment systems to the BPT model treatment system are set out in Table VIII-6. The total estimated costs for the subcategory were determined by mutilplying the unit costs of each treatment component by the number of iron blast furnace sites requiring each component. The total annual costs for BAT were obtained by multiplying the model annual costs by the number of ironmaking operations. The estimated investment and annual costs for each alternative treatment system for the ironmaking subcategory are as follows:

BAT Alternative	Investment Costs(1)		Annual
	In-place	Required	Costs
No.1	$680,000	$10,822,000	$2,182,000
No.2	611,000	16,015,000	3,045,000
No.3	611,000	19,483,000	3,845,000
No.4	3,642,000	38,178,000	8,415,000
No.5	3,642,000	149,409,000	55,922,000

(1) Three plants which already discharge to quenching operations are not considered in alternatives two through five, as the Agency expects that wastewaters from these plants will continue to be disposed of in the same manner.

As noted in Section X, the proposed BAT effluent limitations are based upon BAT Alternative No. 4. The Agency recognizes, however, that wastewaters from some plants will be disposed of by evaporation on slag (Treatment Alternative No. 1). Although less expensive than BAT No.4, BAT No.1 will meet the proposed limitations and achieves zero discharge of pollutants. The Agency decided not to propose limitations based on BAT

Alternative No. 1 because not all dischargers are physically able to use this alternative. However, for the purpose of determining industry cost requirements, the Agency estimated (on the basis of an industry survey) that BAT No. 1 would be installed at 60% of the plants and BAT No. 4 at 40% of the plants. The estimated investment and annual costs of employing these treatment systems in the ironmaking subcategory are as follows:

	Investment Costs		Annual
	In-place	Required	Costs
BAT No.1 (60%)	$ 639,000	$ 6,177,000	$1,293,000
BAT No.4 (40%)	3,642,000	14,398,000	3,630,000
TOTAL	$4,281,000	$20,575,000	$4,923,000

C. BCT Cost Comparison

As noted on the BCT cost analysis, Table VIII-7, the three BCT alternative treatment systems pass the BCT cost test. Refer to Section XI for a review of the applicability of the BCT cost test to the BCT treatment alternatives. The costs to achieve the proposed BCT limitations are included in the BAT costs.

D. Costs Required to Achieve NSPS

Five alternative treatment systems were developed for new blast furnaces which are constructed after promulgation of the New Source Performance Standards. The NSPS alternative treatment systems incorporate the treatment components of the BPT model and BAT alternative treatment sytems. The NSPS treatment model costs are presented in Table VIII-8.

E. Costs Required to Achieve the Pretreatment Standards

Pretreatment standards apply to those plants which continue or elect to discharge to POTW systems. The three pretreatment alternatives are the same as the NSPS Nos. 2, 3, and 4 treatment systems. These systems provide reductions in the effluent levels and loads of various pollutants, in particular, for the toxic pollutants and in effluent flows. Refer to Section XIII for additional information pertaining to pretreatment standards. The model costs for the pretreatment alternatives are the same as the costs for the NSPS Nos. 2,3, and 4 models and are included in Table VIII-8. The costs to achieve the proposed PSES are included in the BPT and BAT costs.

Energy Impacts Due to the Installation of the Alternative Technologies

Comparatively modest amounts of energy are required by the various levels of treatment for the ironmaking subcategory. The major energy expenditures are being incurred at the BPT level while the BAT alternative treatment systems require relatively minor additional energy expenditures. This relationship reflects the use of vacuum filters, cooling towers, and primary recycle technologies (the major energy consumers) in BPT. Energy requirements at the NSPS, PSES and PSNS levels of treatment will be similar to the total of the corresponding BPT and BAT treatment systems.

A. Energy Impacts at BPT

The Agency estimates that the BPT treatment components for all ironmaking operations will use 527.5 million kilowatt hours of electricity per year. This figure represents 0.9% of the 57 billion kilowatt hours of electricity used by the steel industry in 1978.

B. Energy Impacts at BAT

The estimated subcategory BAT energy requirements, and the respective percent of industry power use in 1978, are as follows:

BAT Alternative	kwh per year	% of Industry Usage
No.1	5.40 million	0.009
No.2	3.46 million	0.006
No.3	5.18 million	0.009
No.4	12.96 million	0.023
No.5	27.00 million	0.047

Based on the considerations and data set out in the BAT cost discussion, the Agency has concluded that the energy requirements for the ironmaking subcategory are as follows:

	kwh per year	% of Industry Usage
BAT No.1 (60%)	3.20 million	0.006
BAT No.4 (40%)	5.28 million	0.009
TOTAL	8.48 million	0.015

The Agency considers the energy requirements set out above to be reasonable and justified, especially when compared to the total industry energy use and the pollutant reduction benefits achieved.

C. Energy Impacts at NSPS, PSES and PSNS.

The Agency estimates of the energy requirements for the NSPS and Pretreatment models are as follows:

Model	kwh per Year
NSPS No.1	9.87 million
NSPS No.2	9.83 million
NSPS No.3	9.86 million
NSPS No.4	10.01 million
NSPS No.5	10.27 million

PSES, PSNS No.1	9.83 million
PSES, PSNS No.2	9.86 million
PSES, PSNS No.3	10.01 million

The energy consumption for PSES is included in that for BPT and BAT.

Nonwater Quality Impacts

In general, there are minimal nonwater quality impacts associated with the model technologies. Three impacts were analyzed: air pollution, solid waste disposal, and water consumption. The analysis conducted for the ironmaking subcategory found that no significant nonwater quality impacts will result from the installation of the treatment systems under consideration.

A. Air Pollution

The use of wet cooling towers in the BPT model treatment system may result in the atmospheric discharge of volatile compounds. Cooling tower drift may contain toxic pollutants in levels similar to those of the recycled wastewaters. However, the Agency believes that any adverse environmental impact associated with these emissions is minimal and localized. As no other air pollution impacts are expected as a result of industry's compliance with the proposed BPT limitations, the Agency concluded that there are no significant air pollution impacts associated with the proposed limitations.

With respect to the BAT alternative treatment systems, the evaporation of process wastewaters on slag (BAT Alternative No.1) may result in the emission of pollutants contained in the wastewater into the atmosphere. In the event of treatment process control upsets, sulfides or other reducing agents may be emitted. However, as blast furnace process wastewaters are typically in the neutral or alkaline pH ranges, the possibility of atmospheric emissions, which are aggravated at an acidic pH, is minimized. Activated carbon regeneration (required in association with BAT No. 5), may also result in the emission of some pollutants found in the wastewater. However, under proper operating conditions these pollutants would be incinerated.

B. Solid Waste Disposal

The BPT model and BAT alternative treatment systems will generate quantities of solid wastes. A summary of the solid waste generation rates (on a dry solids basis) at the BPT and BAT levels of treatment for the ironmaking subcategory is as follows:

Treatment Level	Solid Waste Generation for the Subcategory (Tons/Year)
BPT	2.92 million
BAT No. 1	No additional solids generated
BAT No.2	1180
BAT No.3	1840
BAT No.4	4810
BAT No.5	4810

Although the quantities of solids generated at the BPT level are substantial, these solids are often sintered and thus reused in the blast furnace.

The Agency estimates the following solid waste loads at the BAT level of treatment for the ironmaking subcategory.

	Solid Wastes Generation for the Subcategory (tons/year)
BAT No.1 (60%)	No additional solids generated
BAT No.4(40%)	1960
TOTAL	1960

The Agency estimates that the NSPS and Pretreatment alternative treatment systems will generate the following amounts of solid wastes:

Treatment Level	Solid Waste Generation for the Treatment Model(Tons/Year)
NSPS No.1	54,060
NSPS No.2	54,090
NSPS No.3	54,100
NSPS No.4	54,150
NSPS No.5	54,150
PSES, PSNS No.1	54,090
PSES, PSNS No.2	54,100
PSES, PSNS No.3	54,150

As noted previously, the NSPS, PSES, and PSNS alternative treatment systems are similar to the BPT and BAT treatment systems. The solid wastes generated at the NSPS, PSES and PSNS levels of treatment are of the same nature as the solid wastes generated by the BPT model and BAT alternative treatment systems and thus present the same disposal requirements and possibilities for reprocessing.

C. Water Consumption

In the ironmaking subcategory, the Agency has included wet cooling towers in the BPT, BAT, NSPS, PSES and PSNS alternative treatment systems. Wet cooling towers are used to reduce system heat loads and thus permit higher recycle rates. The use of those devices results in some degree of water consumption (in the form of evaporation and drift). In response to the Third Circuit Court's remand of this issue for reconsideration, the Agency carefully analyzed the amount and degree of water consumed, by evaporation and drift, in these cooling devices. In addition, the Agency analyzed the amount of water which will be evaporated for those discharges employing BAT alternative No. 1 (evaporation of process wastewater on slag).

The total water usage in the subcategory is 1036.8 MGD. The Agency estimates that the net amount of water which would be consumed in the ironmaking subcategory at the BPT and BAT levels of treatment are as follows:

	Net Water Consumption	% of Total Volume Applied
BPT	5.4 MGD	0.5
BAT No.1	23.0 MGD	2.2
BAT No.2	0.3 MGD	0.03
BAT No.3	0.3 MGD	0.03
BAT No.4	0.3 MGD	0.03
BAT No.5	0.3 MGD	0.03

The estimates set out above are in addition to the 11.9 MGD of water presently consumed in existing cooling devices (1.1% of total applied volume). Based on the considerations and ratios noted in the BAT cost discussion, the Agency estimates that 13.9 MGD (1.3%) of water would be consumed as a result of applying the BAT levels of treatment to the ironmaking subcategory.

Based on the relevant factors discussed in Section III of Volume I, as well as those discussed above, the Agency has concluded that the impact of the proposed limitations and standards for the ironmaking subcategory on the consumption of water in the steel industry on both a nationwide and an arid and semi-arid regional basis is minimal and justified, especially in light of the effluent reduction benefits associated with these limitations and standards. Recycle systems were in use for blast furnace operations in arid or semi-arid regions prior to promulgation of the previous BPT limitations.

Summary of Impacts

The Agency concludes that the pollution reduction benefits shown above justify any adverse environmental impacts associated with energy consumption, air pollution, solid waste, and water consumption:

	Raw Waste and Effluent Load (Tons/Year)			
	Raw Waste Load	BPT	BAT-1	BAT-4
Flow (MGD)	1,037	40.5	0	22.7
TSS	2,998,300	3082	0	517.8
Toxic Metals	41,280	385.9	0	38.3
Toxic Organics(1)	252	9.9	0	3.8
Ammonia (N)	15,780	6349	0	34.5
Fluoride	15,780	1233	0	345.2
Cyanide, Total	15,780	924.6	0	34.5
Phenols	3,945	246.6	0	3.5

(1)Does not include cyanide or any of the individual phenolic compounds.

TABLE VIII-1

EFFLUENT TREATMENT COSTS
IRON MAKING BLAST FURNACES
(ALL COSTS ARE EXPRESSED IN JULY, 1978 DOLLARS)

Plant Code Reference No.	L 0946A	M 0396A	N 0448A	O 0060F	026 0112D	027 0432A	0684H
Initial Investment Cost	$6,491,520	$1,664,000	$428,370	$6,019,896	$8,216,700	$9,290,280(4)	$5,246,770
Annual Costs							
Cost of Capital(1)	$279,135	$71,552	-	$258,855	$532,500(5)	$399,482	$209,871(5)
Depreciation(2)	649,152	166,400	-	601,990	547,780(5)	$929,028	$349,785(5)
Operation and Maintenance	198,425	NR	-	171,059	1,169,000	407,123	351,410
Energy, Power, Chemicals, etc.	297,790	NR	-	NR	501,000	50,493	241,345
Other (Sludge)	-	-	-	-	-	-	-
Other (Misc.)	-	-	-	-	-	-	141,156
TOTAL	$1,424,502	ISD	-	ISD	$2,750,280	$1,786,126	$1,293,567
$/Ton(5)	$1.626	ISD	-	ISD	$0.725	$0.080	$1.636

TABLE VIII-1
EFFLUENT TREATMENT COSTS
IRON MAKING BLAST FURNACES
PAGE 2

Plant Code Reference No.	-- 0060	-- 0112	-- 0384A			-- 0684F			-- 0868A	-- 0920B
			Plant No. 2	Plant No. 3	Total	Nos. 1 & 4	Nos. 5 & 6	Total		
Initial Investment Cost	$2,963,000(9)	$7,384,290	$14,998,460	$5,897,850	$20,896,310	$12,191,480	$10,315,160	$22,506,640	$4,706,780	$5,171,700
Annual Costs										
Cost of Capital(1)	$ 127,410	$553,822(5)	$644,934	$253,608	$898,542	$975,318(5)	$825,213(5)	$1,800,531(5)	$404,373(8)	$222,383
Depreciation(2)	$ 296,300	410,238(5)	1,499,846	589,785	2,089,631	812,765(5)	687,678(5)	1,500,443(5)	188,271(5)	517,170(5)
Operation and Maintenance	ISD	1,006,686	278,537	484,751	763,288	700,941	698,468	1,399,409	786,132	107,328
Energy, Power, Chemicals, etc.	ISD	91,172	570,861	277,278	848,139	502,394	327,698	830,092	467,004	212,592
Other (Sludge)	-	-	-	438,084	438,084	206,512	124,994	331,506	58,452	-
Other (Misc.)	-	98,860	61,858	125,636	187,494	-	-	-	71,547	-
TOTAL	ISD	$2,160,778(7)	$3,056,036	$2,169,142	$5,225,178	$3,197,930	$2,664,051	$5,861,981	$1,975,779	$1,059,473
$/Ton(6)	ISD	$1.14(7)	$0.778	$1.420	$0.957	$3.067	$1.870	$2.376	$1.668	$1.204

NR : No cost data received.
ISD: Data which was supplied is insufficient to establish blast furnace wastewater treatment costs.

* Confidential

(1) Except where footnoted, the cost of capital is based on the formula, initial investment x 0.043.
(2) Except where footnoted, the depreciation is based on the formula, initial investment x 0.10.
(3) These reported costs most likely reflect an inability to break out the desired costs from the entire gas washer system.
(4) The total cost over a number of years was only supplied. Based on a review of equipment installation dates as presented in the 308 the following apportionment was devised, 75% of total cost in 1951 and 25% in 1971.
(5) Company basis capital cost and depreciation amounts.
(6) Tonnage is based on plant visit or detailed questionnaire data.
(7) This cost does not include operating expense of pickling up drip legs (current construction) but this would be quite minor in comparison to other costs.
(8) This value represents Total Fixed Costs as supplied by the company. This amount includes insurance, capital cost, etc. but not taxes or depreciation.
(9) Does not include all costs (as stated by company).

TABLE VIII-2

EFFLUENT TREATMENT COSTS
FERROMANGANESE BLAST FURNACES
(ALL COSTS ARE EXPRESSED IN JULY, 1978 DOLLARS)

Plant Code Reference No.	Q 0112C	025 0112C
Initial Investmant Cost	\$3,809,500	\$9,296,200 (3)
Annual Costs		
Cost of Capital (1)	163,808	399,737
Depreciation (2)	380,950	929,620
Operation and Maintenance	382,780	491,760
Energy, Power, Chemicals, etc.	151,260	68,844
Other (sludge)	283,118	317,004
TOTAL	\$1,361,916	\$2,206,965
\$/Ton	\$ 6.422	\$ 9.360

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(1) Cost of capital is based on the formula, 0.043 x initial investment.

(2) Depreciation is based on 10% of the initial investment (10 year depreciation).

(3) Inasmuch as a portion of the investment cost covers the period 1964-68, the cost for this period was broken down to 65% in 1964 and 35% in 1967 based on 308 information.

TABLE VIII-3

CONTROL AND TREATMENT TECHNOLOGIES
IRONMAKING SUBCATEGORY

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation & Primary Constituents
A. Thickener-provides solids removal via gravity sedimentation.	Widely used in this subcategory and in other wastewater treatment practices throughout the steel industry. Approximately 90% of blast furnace plants use this technology.	Hydraulic surges must be controlled. Accumulated solids must be continuously or frequently removed to prevent damage to thickener mechanical equipment.	15-18 months	150' x 460'	Air quality impacts are minimal. Settled solids must receive proper disposal, however, they can be reprocessed in the sinter process.	The solid waste generation rate for the treatment model, on the basis of dry solids is 49.4 lb/ton (148 ton/day, 54,100 ton/year). These solids consist primarily of the various metal oxides, primarily iron, hence these solids can be reprocessed via sintering.
B. Polymer Addition-polymer is added to thickener influent to enhance the removal of suspended solids.	Widely used in this subcategory and in other wastewater treatment operations throughout the steel industry. Approximately 43% of blast furnace plants use this technology.	Dissolved solids level will be slightly increased.	6 months	40' x 80'	Increases the amount of solids requiring disposal.	Included with Step A.
C. Vacuum Filter-used to dewater the thickener underflow. Filtrate returned to thickener influent.	Widely used in this subcategory. Approximately 40% of blast furnace plants use this technology.	Routine maintenance, including periodic media replacement is essential for proper equipment performance.	15-18 months	55' x 80'	The dewatered solids must receive proper disposal.	Refer to Step A.
D. Cooling Tower-Used to reduce the recycled wastewater heat load.	Widely used in this subcategory. Approximately 23% of blast furnace plants use this technology. Widely used in other wastewater treatment and recycle systems.	Periodic cleaning and maintenance required. Chemicals must be added to control fouling of the tower.	18-20 months	35' x 70'	Air quality impacts may occur due to evaporation of volatile pollutants, however, these discharges are expected to be minimal. Cooling tower drift may effect immediate site surroundings.	None
E. Recycle-The majority of the thickener effluent is returned to the process.	Widely used in this subcategory. Approximately Approximately 50% of blast furnace plants use recycle.	Scaling, fouling, and plugging are potential problems. Routine maintenance is a necessity. Duplciate piping in critical scale buildup areas will ease problems related to scale buildup.	12-14 months	50' x 60'	None	None

TABLE VIII-3
CONTROL AND TREATMENT TECHNOLOGIES
IRONMAKING SUBCATEGORY
PAGE 2

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation & Primary Constituents
F. Increase recycle rate from 96% to 98%. Provisions are incorporated to increase recycle and thus reduce effluent flow.	Demonstrated on the basis of long-term data.	The problems identified in Item E above remain and must be even more carefully controlled.	6 months	NA - Included in Step E	None	None
G. Evaporation to extinction on slag. The blowdown from Step F is evaporated to extinction on slag.	Several blast furnace plants use recycle blowdown to quench slag. The 70 gal/ton evaporation rate has been demonstrated.	The problems identified in Steps E and F remain.	6 months	NA	Air quality impacts may occur due to discharge of volatile pollutants.	None
H. Filtration-Filters are used to provide additional suspended solids removal.	Used at two blast furnace plants. This technology is also widely used in other subcategory wastewater treatment operations.	Maintenance and backwash schedule should be established to ensure proper filter efficiency. Hydraulic and/or solids overloads must be controlled.	15-18 months	15' x 25'	The backwash solids must receive proper disposal.	The backwash solids represent an additional solids generation rate, on a dry basis of 0.02 lb/ton (123 lb/day, 22 ton/year). These solids are similar in nature to the solids removed in step A.
I. Sulfide precipitation - A sulfide source is added to form metallic sulfide precipitates which are subsequently removed via filtration. Sulfide is also used as a dechlorination agent.	No blast furnace wastewater treatment systems currently use sulfide precipitation technology. However, this technology is demonstrated in the metal finishing industry.	Care must be exercised in the handling of the feed solution. Careful control is necessary.	6 months	10'x10'	Proper disposal must be provided for the additional solids. Air quality impacts may occur due to atmospheric sulfide discharges.	The metal sulfide precipitates, which are removed in the filtration step (Step H), generate an additional dry solids load of 0.003 lb/ton (16 lb/day, 3.0 ton/year) for the treatment model. When used for the purpose of dechlorination, this step generates virtually no solid wastes.

TABLE VIII-3
CONTROL AND TREATMENT TECHNOLOGIES
IRONMAKING SUBCATEGORY
PAGE 3

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation & Primary Constituents
J. Lime addition-used to increase pH of wastewater to 10 or above prior to chlorination.	Several blast furnace operations employ lime addition as part of alkaline chlorination technology.	The pH control system requires routine cleaning, calibration and maintenance. The lime feed and mixing system requires periodic cleaning and maintenance.	12 months	30'x30'	Additional solids will require proper disposal. Dust control while handling lime must be provided.	Included in Step K.
K. Clarifier-provides for gravity sedimentation of the additional solids generated in Step J.	Gravity sedimentation components are demonstrated widely in this subcategory and in other wastewater treatment applications.	Hydraulic surges must be controlled. Accumulated solids must be routinely removed to avoid damage of clarifier mechanical equipment.	15-18 months	40'x40'	Proper disposal of solids must be provided.	When used in alternative nos. 2 or 3, this step results in an additional solids generation rate, on a dry solids basis, of 0.058 lb/ton,(348 lb/day, 63.5 ton/year) for the treatment model. When used in alternatives nos. 4 or 5, this step results in an additional solids generation rate, on a dry solids basis, of 0.061 lb/ton (363 lb/day 66 ton/year) for the treatment model. These solids consist of lime and its precipitates. These solids are dewatered via vacuum filter,Step C.
L. Alkaline chlorination-used to oxidize ammonia, cyanide, phenols, and other contituents amenable to chlorination.	Refer to Step J above.	Chlorine feed control must be properly maintained. Extreme caution must be exercised in the handling of chlorine.	6 months	10'x10'	Potential for localized atmospheric discharges of chlorine.	Included with Step K above.
M. Neutralization - Acid is added to reduce the effluent pH, to the neutral range, prior to discharge.	Demonstrated in this subcategory and in a wide variety of other wastewater treatment operations.	The acid feed and pH control systems require routine cleaning and maintenance. Caution must be exercised in the handling of acid.	8-10 months	10'x20'	Acid fumes must be properly vented and exhausted.	None

TABLE VIII-3
CONTROL AND TREATMENT TECHNOLOGIES
IRONMAKING SUBCATEGORY
PAGE 4

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation & Primary Constituents
N. Granular activated carbon- used to reduce, via adsorption, residual levels of organic pollutants in the effluent of the previous treatment step.	Not used in the treatment of blast furnace wastewaters. However, this technology is used to treat coke plant wastewaters which contain similar organic pollutants.	Close monitoring required. Carbon requires periodic replacement and regeneration. Excessive solids in influent could plug the carbon column.	15-18 months	15'x25'	Substantial amounts of energy are required for carbon regeneration.	None

TABLE VIII-4

BPT MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size-TPD : 6000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	A(3)	B	C(3)	D	E	Total
Investment \$ x 10^{-3}	4365	135	1691	1901	1450	9542
Annual Cost \$ x 10^{-3}						
Capital	187.7	5.8	72.7	81.8	62.4	410.4
Depreciation	436.5	13.5	169.1	190.1	145.0	954.2
Operation and Maintenance	152.8	4.7	59.2	66.5	50.8	334.0
Sludge Disposal	-	-	903.4	-	-	903.4
Energy and Power(1)	4.9	2.1	106.6	130.6	65.3(2)	244.2
Chemical Costs	-	210.2	-	-	-	210.2
TOTAL	781.9	236.3	1311.0	469.0	258.2(2)	3056.4
Less Credit(4)			1292.0			1292.0
Net Total			19.0			1764.4

	Wastewater Parameters	Raw Waste Load(5)	BPT Effluent Level
	Flow, gal/ton	3200	125
	pH, Units	6-9	6-9
	Ammonia (N)	10	103
	Cyanide (T)	10	15
	Phenols	2.5	4
	Fluoride	10	20
	Suspended Solids	1900	50
9	Hexachlorobenzene	0.01	0.01
31	2,4-Dichlorophenol	0.01	0.05
34	2,4-Dimethylphenol	0.05	0.25
39	Fluoranthene	0.08	0.08
65	Phenol	0.65	3.20
73	Benzo(a)pyrene	0.01	0.01
76	Chyrsene	0.01	0.01
84	Pyrene	0.05	0.05

TABLE VIII-4
BPT MODEL COST DATA: BASIS 7/1/78 DOLLARS
PAGE 2

Concentrations, mg/l		Raw Waste Load(5)	BPT Effluent Level
114	Antimony	0.04	0.04
115	Arsenic	0.05	0.05
118	Cadmium	0.05	0.05
119	Chromium	0.50	0.30
120	Copper	0.20	0.10
122	Lead	5.0	0.50
124	Nickel	0.25	0.15
125	Selenium	0.06	0.06
126	Silver	0.01	0.01
128	Zinc	20.0	5.0

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost, as a credit is supplied for existing process water power requirements.
(3) Treatment components are used in tandem.
(4) Credit for recovery of sludge to sinter plant.
(5) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant Aid Addition
C: Vacuum Filter
D: Cooling Tower
E: Recycle 96%

TABLE VIII-5
BPT CAPITAL COST TABULATION
SUBCATEGORY: IRONMAKING

Basis: 7/1/78 Dollars x 10^{-3}
: Facilities in Place as of 1/1/78

Plant Code	TPD	C&TT - STEP A	C&TT - STEP B	C&TT - STEP C	C&TT - STEP D	C&TT - STEP E	In Place	Required	Total
0060	4730	3785	117	1466	1649	1030-266	6581	1692	8273
0060 A	2560	2619	81	1014	1141	870	2619	3106	5725
0060 B	5600	4188	130	1622	-	1391	7331	0	7331
0060 F	2200	2391	74	926	1041	413-381	4845	381	5226
0112	10600	6142	191	2379	2675	1959-82	13346	82	13428
0112 A	19140	8756	272	3391	3814	2792-116	15634	3507	19141
0112 B	12550	6797	-	2633	2961	2258	14649	0	14649
0112 C	5200	4006	124	1552	1745	532-799	7835	923	8758
0112 D	10500	6107	189	2365	2660	1948-81	13269	81	13350
0248 A	2000	2258	70	875	984	750	3203	1734	4937
0256 E	2000	2258	70	875	984	759	3133	1804	4937
0320	6275	4484	139	1737	1953	1490	6221	3582	9803
0384 A	22200	9571	297	3707	4169	3116-64	17153	3771	20924
0396 A	3400	3105	96	1203	1352	1031	6787	0	6787
0396 C	3180	2982	93	-	-	991	4066	0	4066
0426	1100	1577	49	611	687	333-191	3208	240	3448
0432 A	11000	6280	195	2432	2735	2086	8907	4821	13728
0432 B	5275	4041	125	1565	1760	1342	5731	3102	8833
0432 C	5367	4083	127	1581	-	1144-212	6935	212	7147
0448 A	7200	4870	151	-	2121	1618	8609	151	8760
0492 A	1200	1662	52	644	724	458-94	2764	870	3634
0528 A	5000	3913	121	1516	1704	1300	8554	0	8554
0584 B	10900	6246	194	2419	2720	2075	8665	4989	13654
0584 C	5200	4006	124	1552	1745	1331	4006	4752	8758
0584 D	2150	2358	73	913	1027	783	3271	1883	5154
0584 F	8020	5196	161	2012	2263	1726	7208	4150	11358
0684 A	2520	2594	80	1005	1130	862	3599	2072	5671
0684 B	2800	2763	86	1070	1204	918	2763	3278	6041
0684 F	9200	5642	175	2185	2457	1874	12333	0	12333
0684 G	3150	2966	92	1149	1292	985	4207	2277	6484
0684 H	2870	2804	87	1086	1222	893-93	6038	93	6131

TABLE VIII-5
BPT CAPITAL COST TABULATION
SUBCATEGORY: IRONMAKING
PAGE 2

Plant Code	TPD	A	B	C	D	E	In Place	Required	Total
0684 I	2200	2391	74	926	1041	794	3391	1835	5226
0724 A	2800	2763	86	1070	1204	142-776	2905	3136	6041
0732 A	800	1303	40	505	568	432	2240	608	2848
0856 B	8600	5418	168	2098	2360	1800	7516	4328	11844
0856 F	8206	5267	163	2040	2294	1750	5267	6247	11514
0856 I	6400	4537	141	1758	1976	1507	6436	3483	9919
0856 N	8000	5188	161	2009	2260	1723	5188	6153	11341
0856 O	1234	1690	52	655	736	561	2397	1297	3694
0856 Q	1100	1577	-	611	-	524	2712	0	2712
0856 R	6750	4685	145	1815	2041	965-591	7465	2777	10242
0856 T	4707	3774	117	1462	1644	1254	0	8251	8251
0860 B	20611	9153	284	3545	3987	3041	9437	10573	20010
0860 H	9912	5900	183	2285	2570	1960	12898	0	12898
0864 A	5700	4233	131	1640	1844	731-675	4964	4290	9254
0868 A	8054	5209	162	2017	2269	1540-190	9180	2207	11387
0920 A	3100	2937	91	1138	1279	976	4075	2346	6421
0920 B	4400	3624	112	1404	1579	1204	7923	0	7923
0920 N	4200	3524	109	1365	1535	1171	4889	2815	7704
0946 A	2400	2519	78	976	1097	837	3573	1934	5507
0948 A	5400	4098	127	1587	1785	599-762	6284	2674	8958
0948 B	1055	1538	48	596	670	511	0	3363	3363
0948 C	10700	6177	192	2392	2690	2011-41	13270	233	13503
							345480*	122103*	467583*

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* Totals do not include confidential plants.

Note: Underlined costs represent facilities in place. Where two figures appear in the same column, the underlined portion is in place; the non-underlined portion remains to be installed.

Legend

A - Thickener
B - Coagulant Aid Addition
C - Vacuum Filter
D - Cooling Filter
E - Recycle 96%

TABLE VIII-6

ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size-TPD : 6000
Oper. Days/Year: 365
Turns/Day : 3

Alternative	No. 1			No. 2			No. 3			No. 4						No. 5		
C&TT Steps	F	G	Total	F	H	Total	F,H	I	Total	F,H,I	J	K	L	M	Total	F,H,I,J,K,L	M	Total
Investment $ x 10^{-3}	41	172	213		285	326		68	394		94	233	44	55	820		2181	3001
Annual Costs $ x 10^{-3}																		
Capital	1.8	7.4	9.2		12.3	14.1		2.9	17.0		4.0	10.0	1.9	2.4	35.3		93.8	129.1
Depreciation	4.1	17.2	21.3		28.5	32.6		6.8	39.4		9.4	23.3	4.4	5.5	82.0		218.1	300.1
Operation and Maintenance(1)	1.4	6.0	7.4		10.0	11.4		2.4	13.8		3.3	8.2	1.5	1.9	28.7		76.3	105.0
Energy and Power	1.6(2)	2.5	2.5		1.6	1.6		0.8	2.4		1.6	1.2	0.2	0.6	6.0		6.5	12.5
Chemical Costs	-	-	-		-	-		2.6	2.6		2.2	-	4.8	3.4	13.0		-	13.0
Carbon Regeneration	-	-	-		-	-		-	-		-	-	-	-	-		536.8	536.8
TOTAL	7.3(2)	33.1	40.4		52.4	59.7		15.5	75.2		20.5	42.7	12.8	13.8	165.0		931.5	1096.5

	Wastewater Parameters	BAT Feed Level	BAT No.1 Effluent Level	BAT No.2 Effluent Level	BAT No.3 Effluent Level	BAT No.4 Effluent Level	BAT No.5 Effluent Level
	Flow, gal/ton	125	0	70	70	70	70
	pH (Units)	6-9		6-9	6-9	6-9	6-9
	Ammonia (as N)	103		50	50	1.0	1.0
121	Cyanide (T)	15		2.5	2.5	1.0	1.0
	Phenols	4	NO	3	3	0.1	0.05
	Fluoride	20		20	20	10	10
	Chlorine (Residual)		WASTE-	-	-	0.5	0.5
	Suspended Solids	30	WATER	15	15	15	15
9	Hexachlorobenzene	0.01		0.01	0.01	0.01	0.01
31	2,4-Dichlorophenol	0.05	DISCHARGE	0.05	0.05	0.05	0.05
34	2,4-Dimethylphenol	0.25		0.25	0.25	0.05	0.05
39	Fluoranthene	0.08		0.08	0.08	0.08	0.01
65	Phenol	3.20		3.20	3.20	0.05	0.05

TABLE VIII-6
ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 2

Concentrations, mg/l		BAT Feed Level	BAT No.1 Effluent Level	BAT No.2 Effluent Level	BAT No.3 Effluent Level	BAT No.4 Effluent Level	BAT No.5 Effluent Level
73	Benzo(a)pyrene	0.01	NO WASTEWATER DISCHARGE	0.01	0.01	0.01	0.01
76	Chrysene	0.01		0.01	0.01	0.01	0.01
84	Pyrene	0.05		0.05	0.05	0.05	0.01
114	Antimony	0.04		0.04	0.04	0.04	0.04
115	Arsenic	0.05		0.05	0.05	0.05	0.05
118	Cadmium	0.05		0.05	0.05	0.05	0.05
119	Chromium	0.30		0.25	0.10	0.15	0.15
120	Copper	0.10		0.10	0.10	0.10	0.10
122	Lead	0.50		0.30	0.15	0.25	0.25
124	Nickel	0.15		0.15	0.10	0.10	0.10
125	Selenium	0.06		0.06	0.06	0.06	0.06
126	Silver	0.01		0.01	0.01	0.01	0.01
128	Zinc	5.00		4.50	0.25	0.30	0.30

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power as a credit is supplied for existing process water requirements.

KEY TO C&TT STEPS

F: Increase recycle rate to 98 %
G: Evaporation to extinction on slag
H: Filtration
I: Sulfide Addition
J: pH adjustment with lime
K: Clarifier
L: Alkaline Chlorination
M: Neutralization with acid
N: Granular activated carbon columns

TABLE VIII-7

RESULTS OF BCT COST TEST
IRONMAKING SUBCATEGORY

A. BCT Feed

Effluent concentration of conventional pollutants = 50 mg/l
Flow = 0.75 MGD
Day/Year = 365
lbs/Year of conventional pollutants discharged = 114,154

B. BCT-1

Effluent concentration of conventional pollutants = 0
Flow = 0
Days/Year = 365
lbs/Year of conventional pollutants discharged = 0

lbs/Year of conventional pollutants removed via treatment
114,154 - 0 = 114,154

Annual cost of BCT-1 = $40,400* $/lb = 0.35 PASS
* Includes all C&TT Steps.

C. BCT-2

Effluent concentrations of conventional pollutants = 15 mg/l
Flow = 0.42 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 19,191

lbs/Year of conventional pollutants removed via treatment
114,154 - 19,178 = 94,976

Annual Cost of BCT System = $59,700* $/lb = 0.63 PASS
* Includes only the recycle and filtration steps.

D. BCT-3

Effluent concentration of conventional pollutants = 15 mg/l
Flow = 0.42 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 19,191

lbs/Year of conventional pollutants removed via treatment
114,154 - 19,178 = 94,976

Annual Cost of BCT System = $102,400* $/lb = 1.08 PASS

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* Includes only the recycle, clarification, and filtration steps.

TABLE VIII-6

NSPS, PSES AND PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size-TPD : 6000
Oper. Days/Year: 365
Turns/Day : 3

Alternative	NSPS Alternative No. 1							NSPS Alternative No. 2; PSES and PSNS Alternative No. 1			NSPS Alternative No. 3; PSES and PSNS Alternative No. 2		
C&TT Steps	A(3)	B	C(3)	D	E	F	Total	A through E	G	Total	A through E & G	H	Total
Investment $ x 10^{-3}	4635	135	1691	1901	1466	172	9730		285	9843		68	9911
Annual Costs $ x 10^{-3}													
Capital	187.7	5.8	72.7	81.8	63.0	7.4	418.4		12.3	423.3		2.9	426.2
Depreciation	436.5	13.5	169.1	190.1	146.6	17.2	973.0		28.5	984.3		6.8	991.1
Operation and Maintenance	152.8	4.7	59.2	66.5	51.3	6.0	340.5		10.0	344.5		2.4	346.9
Sludge Disposal	-	-	903.4	-	-	-	903.4		-	903.4		-	903.4
Energy and Power(1)	4.9	2.1	106.6	130.6	65.3(2)	3.3	244.2		1.6	245.8		0.8	246.6
Chemical Costs	-	210.2	-	-	-	-	210.2		-	210.2		2.6	212.8
Carbon Regeneration	-	-	-	-	-	-	-		-	-		-	-
TOTAL	781.9	236.3	1311.0	469.0	260.9(2)	33.1	3092.2		32.4	3111.5		15.5	3127.0
Less Credit(4)			1292.0				1292.0			1292.0			1292.0
Net Total			19.0				1800.2			1819.5			1835.0

	Wastewater Parameters	Raw Waste Level(5)	NSPS No.1 Effluent Level	NSPS No.2; PSES and PSNS No. 1 Effluent Level	NSPS No.3; PSES and PSNS No. 2 Effluent Level
	Flow, gal/ton	3200	0	70	70
	pH, Units	6-10		6-9	6-9
	Ammonia (as N)	10		50	50
	Cyanide (T)	10	NO	2.5	2.5
	Phenols	2.5		3	3
	Fluoride	10	WASTE-	20	20
	Suspended Solids	1900		15	15
			WATER		
9	Hexachlorobenzene	0.01		0.01	0.01
31	2,4-Dichlorophenol	0.01		0.05	0.05
34	2,4-Dimethylphenol	0.05		0.25	0.25

TABLE VIII-8
NSPS, PSES and PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 2

Concentration, mg/l		Raw Waste Load(5)	NSPS No.1 Effluent Level	NSPS No. 2; PSES AND PSNS No.1 Effluent Level	NSPS No. 3; PSES and PSNS No. 2 Effluent Level
39	Fluoranthene	0.08	NO	0.08	0.08
65	Phenol	0.65		3.20	3.20
73	Benzo-a-pyrene	0.01	WASTE-	0.01	0.01
76	Chrysene	0.01		0.01	0.01
84	Pyrene	0.05	WATER	0.05	0.05
114	Antimony	0.04	DISCHARGE	0.04	0.04
115	Arsenic	0.05		0.05	0.05
118	Cadmium	0.05		0.05	0.05
119	Chromium	0.50		0.25	0.10
120	Copper	0.20		0.10	0.10
122	Lead	5.0		0.30	0.15
124	Nickel	0.25		0.15	0.10
125	Selenium	0.06		0.06	0.06
126	Silver	0.01		0.01	0.01
128	Zinc	20		4.50	0.25

TABLE VIII-8
NSPS, PSES and PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 3

Alternative	NSPS Alternative No. 4; PSES and PSNS Alternative No.3						NSPS Alternative No. 5		
C&TT Steps	A through E, G & H	I	J	K	L	Total	A through E, G through L	M	Total
Investment $ x 10^{-3}		94	233	44	55	10,337		2181	12,518
Annual Costs $ x 10^{-3}									
Capital		4.0	10.0	1.9	2.4	444.5		93.8	538.3
Depreciation		9.4	23.3	4.4	5.5	1033.7		218.1	1251.8
Operation & Maintenance		3.3	8.2	1.5	1.9	361.8		76.3	438.1
Sludge Disposal		-	-	-	-	903.4		-	903.4
Energy and Power$^{(1)}$		1.6	1.2	0.2	0.6	250.2		6.5	256.7
Chemical Costs		2.2	-	4.8	3.4	223.2		-	223.2
Carbon Regeneration		-	-	-	-	-		536.8	536.8
TOTAL		20.5	42.7	12.8	13.8	3216.8		931.5	4148.3
Less Credit$^{(4)}$						1292.0			1292.0
Net Total						1924.8			2856.3

	Wastewater Parameters	NSPS No. 4 and PTS No. 3 Effluent Level	NSPS No. 5 Effluent Level
	Flow, gal/ton	70	70
	pH	6-9	6-9
	Ammonia (as N)	1.0	1.0
	Cyanide (T)	1.0	1.0
	Phenols	0.1	0.05
	Fluoride	10	10
	Chlorine (Residual)	0.5	0.5
	Suspended Solids	15	15
9	Hexachlorobenzene	0.01	0.01
31	2,4-Dichlorophenol	0.05	0.05
34	2,4-Dimethylphenol	0.05	0.05
39	Fluoranthene	0.08	0.01
65	Phenol	0.05	0.05

TABLE VIII-8
NSPS AND PTS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 4

Concentrations, mg/l		NSPS No. 4; PSES and PSNS No. 3 Effluent Level	NSPS No. 5 Effluent Level
73	Benzo-a-pyrene	0.01	0.01
76	Chrysene	0.01	0.01
84	Pyrene	0.05	0.01
114	Antimony	0.04	0.04
115	Arsenic	0.05	0.05
118	Cadmium	0.05	0.05
119	Chromium	0.15	0.15
120	Copper	0.10	0.10
122	Lead	0.25	0.25
124	Nickel	0.10	0.10
125	Selenium	0.06	0.06
126	Silver	0.01	0.01
128	Zinc	0.30	0.30

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for process water requirements.
(3) Treatment components are used in tandem.
(4) Credit for recovery of sludge to sinter plant.
(5) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant aid addition
C: Vacuum filter
D: Cooling tower
E: Recycle 98%
F: Evaporation to extinction on slag
G: Filtration

H: Sulfide addition
I: Lime pH adjustment
J: Clarifier
K: Alkaline chlorination
L: Neutralization with acid
M: Granular activated carbon columns

TABLE VIII-3
CONTROL AND TREATMENT TECHNOLOGIES
IRONMAKING SUBCATEGORY
PAGE 4

Treatment and/or Control Methods Employed	Status and Reliability	Problems and Limitations	Implementation Time	Land Requirements	Environmental Impact Other Than Water	Solid Waste Generation & Primary Constituents
N. Granular activated carbon-used to reduce, via adsorption, residual levels of organic pollutants in the effluent of the previous treatment steps).	Not used in the treatment of blast furnace wastewaters. However, this technology is used to treat coke plant wastewaters which contain similar organic pollutants.	Close monitoring required. Carbon requires periodic replacement and regeneration. Excessive solids in influent could plug the carbon column.	15-18 months	15'x25'	Substantial amounts of energy are required for carbon regeneration.	None

TABLE VIII-4

BPT MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size-TPD : 6000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	A(3)	B	C(3)	D	E	Total
Investment $ x 10^{-3}	4365	135	1691	1901	1450	9542
Annual Cost $ x 10^{-3}						
Capital	187.7	5.8	72.7	81.8	62.4	410.4
Depreciation	436.5	13.5	169.1	190.1	145.0	954.2
Operation and Maintenance	152.8	4.7	59.2	66.5	50.8	334.0
Sludge Disposal	—	—	903.4	—	—	903.4
Energy and Power(1)	4.9	2.1	106.6	150.6	65.3(2)	[illegible]
Chemical Costs	—	2102.2	—	—	—	2102.2
TOTAL	781.9	2128.3	1311.0	489.0	323.5(2)	[illegible]
Less Credit(4)			1292.0			1292.0
Net Total			19.0			[illegible]

	Wastewater Parameters	Raw Waste Load(5)	BPT Effluent Level
	Flow, gal/ton	2200	125
	pH, Units	6-9	6-9
	Ammonia (N)	10	103
	Cyanide (T)	10	15
	Phenols	2.5	4
	Fluoride	10	20
	Suspended Solids	1900	50
9	Hexachlorobenzene	0.01	0.01
31	2,4-Dichlorophenol	0.01	0.05
34	2,4-Dimethylphenol	0.05	0.25
39	Fluoranthene	0.08	0.08
65	Phenol	0.65	3.20
73	Benzo(a)pyrene	0.01	0.01
76	Chyrsene	0.01	0.01
84	Pyrene	0.05	0.05

TABLE VIII-4
BPT MODEL COST DATA: BASIS 7/1/78 DOLLARS
PAGE 2

Concentrations, mg/l		Raw Waste Load(5)	BPT Effluent Level
114	Antimony	0.06	0.06
115	Arsenic	0.05	0.05
118	Cadmium	0.05	0.05
119	Chromium	0.50	0.30
120	Copper	0.20	0.10
122	Lead	5.0	0.50
124	Nickel	0.25	0.15
125	Selenium	0.06	0.06
126	Silver	0.01	0.01
128	Zinc	20.0	5.0

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost, as a credit is supplied for existing process water power requirements.
(3) Treatment components are used in tandem.
(4) Credit for recovery of sludge to sinter plant.
(5) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant aid addition
C: Vacuum Filter
D: Cooling Tower
E: Recycle 98%

[illegible]

[illegible]

[illegible]

[illegible] as of 1/1/78

Plant Code	MWe	[illegible]					In Place	Required	Total
		A	B	C	D	E			
0060	6790	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0060 A	2560	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0060 B	5600	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0060 F	2200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0112	10000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0112 A	19040	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0112 B	12550	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0112 C	5200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0112 D	10500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0248 A	2000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0256 E	2000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0320	6275	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0386 A	22200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0396 A	9600	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0396 C	3180	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0426	1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0432 A	11000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0432 B	5275	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0432 C	5367	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0448 A	7200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0492 A	1200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0528 A	5000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0584 B	10900	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0584 C	5200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0584 D	2150	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0584 F	8020	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0684 A	2520	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0684 B	2800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0684 F	9200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0684 C	3150	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0684 H	2870	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE VIII-5
BPT CAPITAL COST TABULATION
SUBCATEGORY: IRONMAKING
PAGE 2

Plant Code	TPD	A	B	C	D	E	In Place	Required	Total
0684 I	2200	2391	74	926	1041	794	3391	1835	5226
0724 A	2800	2763	86	1070	1204	142-776	2905	3136	6041
0732 A	800	1303	40	505	568	432	2240	608	2848
0856 B	8600	5418	168	2098	2360	1800	7516	4328	11844
0856 F	8206	5267	163	2040	2294	1750	5267	6247	11514
0856 I	6400	4537	141	1758	1976	1507	6436	3483	9919
0856 N	8000	5188	161	2009	2260	1723	5188	6153	11341
0856 O	1234	1690	52	655	736	561	2397	1297	3694
0856 Q	1100	1577	-	611	-	524	2712	0	2712
0856 R	6750	4685	145	1815	2041	965-591	7465	2777	10242
0856 T	4707	3774	117	1462	1644	1254	0	8251	8251
0860 B	20611	9153	284	3545	3987	3041	9437	10573	20010
0860 H	9912	5900	183	2285	2570	1960	12898	0	12898
0864 A	5700	4233	131	1640	1844	731-675	4964	4290	9254
0868 A	8054	5209	162	2017	2269	1540-190	9180	2207	11387
0920 A	3100	2937	91	1138	1279	976	4075	2346	6421
0920 B	4400	3624	112	1404	1579	1204	7923	0	7923
0920 H	4200	3524	109	1365	1535	1171	4889	2815	7704
0946 A	2400	2519	78	976	1097	837	3573	1934	5507
0948 A	5400	4098	127	1587	1785	599-762	6284	2674	8958
0948 B	1055	1538	48	596	670	511	0	3363	3363
0948 C	10700	6177	192	2392	2690	2011-41	13270	233	13503
							345480*	122103*	467583*

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* Totals do not include confidential plants.

Note: Underlined costs represent facilities in place. Where two figures appear in the same column, the underlined portion is in place; the non-underlined portion remains to be installed.

Legend

A - Thickener
B - Coagulant Aid Addition
C - Vacuum Filter
D - Cooling Filter
E - Recycle 96%

TABLE VIII-6

ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size-TPD : 6000
Oper. Days/Year: 365
Turns/Day : 3

Alternative	No. 1			No. 2			No. 3			No. 4						No. 5		
C&TT Steps	F	G	Total	F	H	Total	F,H	I	Total	F,H,I	J	K	L	M	Total	F,H,I,J,K,L	M	Total
Investment $ x 10^{-3}	41	172	213		285	326		68	394		94	233	44	55	820		2181	3001
Annual Costs $ x 10^{-3}																		
Capital	1.8	7.4	9.2		12.3	14.1		2.9	17.0		4.0	10.0	1.9	2.4	35.3		93.8	129.1
Depreciation	4.1	17.2	21.3		28.5	32.6		6.8	39.4		9.4	23.3	4.4	5.5	82.0		218.1	300.1
Operation and Maintenance	1.4(2)	6.0	7.4		10.0	11.4		2.4	13.8		3.3	8.2	1.5	1.9	28.7		76.3	105.0
Energy and Power(1)	1.6	2.5	2.5		1.6	1.6		0.8	2.4		1.6	1.2	0.2	0.6	6.0		6.5	12.5
Chemical Costs	-	-	-		-	-		2.6	2.6		2.2	-	4.8	3.4	13.0		-	13.0
Carbon Regeneration	-	-	-		-	-		-	-		-	-	-	-	-		536.8	536.8
TOTAL	7.3(2)	33.1	40.4		52.4	59.7		15.5	75.2		20.5	42.7	12.8	13.8	165.0		931.5	1096.5

	Wastewater Parameters	BAT Feed Level	BAT No.1 Effluent Level	BAT No.2 Effluent Level	BAT No.3 Effluent Level	BAT No.4 Effluent Level	BAT No.5 Effluent Level
	Flow, gal/ton	125	0	70	70	70	70
	pH (Units)	6-9		6-9	6-9	6-9	6-9
	Ammonia (as N)	103		50	50	1.0	1.0
121	Cyanide (T)	15		2.5	2.5	1.0	1.0
	Phenols	4	NO	3	3	0.1	0.05
	Fluoride	20		20	20	10	10
	Chlorine (Residual)		WASTE-	-	-	0.5	0.5
	Suspended Solids	50		15	15	15	15
9	Hexachloro-benzene	0.01	WATER	0.01	0.01	0.01	0.01
31	2,4-Dichloro-phenol	0.05	DISCHARGE	0.05	0.05	0.05	0.05
34	2,4-Dimethyl-phenol	0.25		0.25	0.25	0.05	0.05
39	Fluoranthene	0.08		0.08	0.08	0.08	0.01
65	Phenol	3.20		3.20	3.20	0.05	0.05

TABLE VIII-6
ALTERNATIVE BAT MODEL COSTS: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 2

Concentrations, mg/l		BAT Feed Level	BAT No.1 Effluent Level	BAT No.2 Effluent Level	BAT No.3 Effluent Level	BAT No.4 Effluent Level	BAT No.5 Effluent Level
73	Benzo(a)pyrene	0.01		0.01	0.01	0.01	0.01
76	Chrysene	0.01	NO	0.01	0.01	0.01	0.01
84	Pyrene	0.05		0.05	0.05	0.05	0.01
			WASTE-				
114	Antimony	0.04		0.04	0.04	0.04	0.04
115	Arsenic	0.05	WATER	0.05	0.05	0.05	0.05
118	Cadmium	0.05		0.05	0.05	0.05	0.05
119	Chromium	0.30	DISCHARGE	0.25	0.10	0.15	0.15
120	Copper	0.10		0.10	0.10	0.10	0.10
122	Lead	0.50		0.30	0.15	0.25	0.25
124	Nickel	0.15		0.15	0.10	0.10	0.10
125	Selenium	0.06		0.06	0.06	0.06	0.06
126	Silver	0.01		0.01	0.01	0.01	0.01
128	Zinc	5.00		4.50	0.25	0.30	0.30

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power as a credit is supplied for existing process water requirements.

KEY TO C&TT STEPS

F: Increase recycle rate to 98 %
G: Evaporation to extinction on slag
H: Filtration
I: Sulfide Addition
J: pH adjustment with lime
K: Clarifier
L: Alkaline Chlorination
M: Neutralization with acid
N: Granular activated carbon columns

TABLE VIII-7

RESULTS OF BCT COST TEST
IRONMAKING SUBCATEGORY

A. BCT Feed

Effluent concentration of conventional pollutants = 50 mg/l
Flow = 0.75 MGD
Day/Year = 365
lbs/Year of conventional pollutants discharged = 114,154

B. BCT-1

Effluent concentration of conventional pollutants = 0
Flow = 0
Days/Year = 365
lbs/Year of conventional pollutants discharged = 0

lbs/Year of conventional pollutants removed via treatment
114,154 - 0 = 114,154

Annual cost of BCT-1 = $40,400* $/lb = 0.35 PASS
* Includes all C&TT Steps.

C. BCT-2

Effluent concentrations of conventional pollutants = 15 mg/l
Flow = 0.42 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 19,191

lbs/Year of conventional pollutants removed via treatment
114,154 - 19,178 = 94,976

Annual Cost of BCT System = $59,700* $/lb = 0.63 PASS
* Includes only the recycle and filtration steps.

D. BCT-3

Effluent concentration of conventional pollutants = 15 mg/l
Flow = 0.42 MGD
Days/Year = 365
lbs/Year of conventional pollutants discharged = 19,191

lbs/Year of conventional pollutants removed via treatment
114,154 - 19,178 = 94,976

Annual Cost of BCT System = $102,400* $/lb = 1.08 PASS

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* Includes only the recycle, clarification, and filtration steps.

TABLE VIII-8

NSPS, PSES AND PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size-TPD : 6000
Oper. Days/Year: 365
Turns/Day : 3

Alternative	NSPS Alternative No. 1							NSPS Alternative No. 2; PSES and PSNS Alternative No. 1			NSPS Alternative No. 3; PSES and PSNS Alternative No. 2		
C&TT Steps	A(3)	B	C(3)	D	E	F	Total	A through E	G	Total	A through E & G	H	Total
Investment $ x 10^{-3}	4635	135	1691	1901	1466	172	9730		285	9843		68	9911
Annual Costs $ x 10^{-3}													
Capital	187.7	5.8	72.7	81.8	63.0	7.4	418.4		12.3	423.3		2.9	426.2
Depreciation	436.5	13.5	169.1	190.1	146.6	17.2	973.0		28.5	984.3		6.8	991.1
Operation and Maintenance	152.8	4.7	59.2	66.5	51.3	6.0	340.5		10.0	344.5		2.4	346.9
Sludge Disposal	-	-	903.4	-	-	-	903.4		-	903.4		-	903.4
Energy and Power(1)	4.9	2.1	106.6	130.6	65.3(2)	2.5	246.7		1.6	245.8		0.8	246.6
Chemical Costs	-	210.2	-	-	-	-	210.2		-	210.2		2.6	212.8
Carbon Regeneration	-	-	-	-	-	-	-		-	-		-	-
TOTAL	781.9	236.3	1311.0	469.0	260.9(2)	33.1	3092.2		52.4	3111.5		15.5	3127.0
Less Credit(4)			1292.0				1292.0			1292.0			1292.0
Net Total			19.0				1800.2			1819.5			1835.0

	Wastewater Parameters	Raw Waste Level(5)	NSPS No.1 Effluent Level	NSPS No.2; PSES and PSNS No. 1 Effluent Level	NSPS No.3; PSES and PSNS No. 2 Effluent Level
	Flow, gal/ton	3200	0	70	70
	pH, Units	6-10		6-9	6-9
	Ammonia (as N)	10		50	50
	Cyanide (T)	10	NO	2.5	2.5
	Phenols	2.5		3	3
	Fluoride	10	WASTE-	20	20
	Suspended Solids	1900		15	15
			WATER		
9	Hexachlorobenzene	0.01		0.01	0.01
31	2,4-Dichlorophenol	0.01		0.05	0.05
34	2,4-Dimethylphenol	0.05		0.25	0.25

TABLE VIII-8
NSPS, PSES and PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 2

Concentration, mg/l	Raw Waste Load(5)	NSPS No.1 Effluent Level	NSPS No. 2; PSES AND PSNS No.1 Effluent Level	NSPS No. 3; PSES and PSNS No. 2 Effluent Level
39 Fluoranthene	0.08	NO	0.08	0.08
65 Phenol	0.65		3.20	3.20
73 Benzo-a-pyrene	0.01	WASTE-	0.01	0.01
76 Chrysene	0.01		0.01	0.01
84 Pyrene	0.05	WATER	0.05	0.05
114 Antimony	0.04	DISCHARGE	0.04	0.04
115 Arsenic	0.05		0.05	0.05
118 Cadmium	0.05		0.05	0.05
119 Chromium	0.50		0.25	0.10
120 Copper	0.20		0.10	0.10
122 Lead	5.0		0.30	0.15
124 Nickel	0.25		0.15	0.10
125 Selenium	0.06		0.06	0.06
126 Silver	0.01		0.01	0.01
128 Zinc	20		4.50	0.25

TABLE VIII-6
NSPS, PSES and PSNS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 3

Alternative C&TT Steps	NSPS Alternative No. 4; PSES and PSNS Alternative No.3						NSPS Alternative No. 5		
	A through E, G & H	I	J	K	L	Total	A through E, G through L	M	Total
Investment $ x 10^{-3}		94	233	44	55	10,337		2181	12,518
Annual Costs $ x 10^{-3}									
Capital		4.0	10.0	1.9	2.4	444.5		93.8	538.3
Depreciation		9.4	23.3	4.4	5.5	1033.7		218.1	1251.8
Operation & Maintenance		3.3	8.2	1.5	1.9	361.8		76.3	438.1
Sludge Disposal		-	-	-	-	903.4		-	903.4
Energy and Power(1)		1.6	1.2	0.2	0.6	250.2		6.5	256.7
Chemical Costs		2.2	-	4.8	3.4	223.2		-	223.2
Carbon Regeneration		-	-	-	-	-		536.8	536.8
TOTAL		20.5	42.7	12.8	13.8	3216.8		931.5	4148.3
Less Credit(4)						1292.0			1292.0
Net Total						1924.8			2856.3

Wastewater Parameters	NSPS No. 4 and PTS No. 3 Effluent Level	NSPS No. 5 Effluent Level
Flow, gal/ton	70	70
pH	6-9	6-9
Ammonia (as N)	1.0	1.0
Cyanide (T)	1.0	1.0
Phenols	0.1	0.05
Fluoride	10	10
Chlorine (Residual)	0.5	0.5
Suspended Solids	15	15
9 Hexachlorobenzene	0.01	0.01
31 2,4-Dichlorophenol	0.05	0.05
34 2,4-Dimethylphenol	0.05	0.05
39 Fluoranthene	0.08	0.01
65 Phenol	0.05	0.05

TABLE VIII-8
NSPS AND PTS MODEL COST DATA: BASIS 7/1/78 DOLLARS
SUBCATEGORY: IRONMAKING
PAGE 4

Concentrations, mg/l		NSPS No. 4; PSES and PSNS No. 3 Effluent Level	NSPS No. 5 Effluent Level
73	Benzo-a-pyrene	0.01	0.01
76	Chrysene	0.01	0.01
84	Pyrene	0.05	0.01
114	Antimony	0.04	0.04
115	Arsenic	0.05	0.05
118	Cadmium	0.05	0.05
119	Chromium	0.15	0.15
120	Copper	0.10	0.10
122	Lead	0.25	0.25
124	Nickel	0.10	0.10
125	Selenium	0.06	0.06
126	Silver	0.01	0.01
128	Zinc	0.30	0.30

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(1) Costs are all power unless otherwise noted.
(2) Total does not include power cost as a credit is supplied for process water requirements.
(3) Treatment components are used in tandem.
(4) Credit for recovery of sludge to sinter plant.
(5) Raw wastewater quality reflects the discharge of a once-through system.

KEY TO C&TT STEPS

A: Thickener
B: Coagulant aid addition
C: Vacuum filter
D: Cooling tower
E: Recycle 98%
F: Evaporation to extinction on slag
G: Filtration

H: Sulfide addition
I: Lime pH adjustment
J: Clarifier
K: Alkaline chlorination
L: Neutralization with acid
M: Granular activated carbon columns

IRONMAKING SUBCATEGORY

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

The Agency has decided to propose the same limitations that were originally promulgated in June 1974 [1]as the Best Practicable Control Technology Currently Available (BPT) limitations. The June 1974 development document[2] described the methods used by the Agency in developing the originally promulgated limitations. This section focuses on the achievability of those limitations.

Identification of BPT

A. Iron Making Blast Furnaces

The BPT model treatment system includes sedimentation in a thickener; coagulant aid addition for enhanced solids removal performance; sludge dewatering or vacuum filtration; and, the recycle through a cooling tower of about 96% of the thickener effluent. The remaining thickener effluent is discharged as a blowdown. Figure IX-1 depicts the treatment system described above.

B. Ferromanganese Blast Furnaces

The iron blast furnace BPT model treatment system applies to ferromanganese blast furnace operations as well. However, different BPT effluent limitations are proposed to account for the higher blowdown concentrations of pollutants limited at BPT for ferromanganese furnaces.

Table IX-1 summarizes the characteristics of iron making and ferromanganese blast furnace process wastewaters. The proposed 30-day average BPT effluent limitations are as follows.

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[1] Federal Register; Friday, June 28, 1974; Part II, Environmental Protection Agency: Iron and Steel Manufacturing Point Source Category; Effluent Guidelines and Standards; Pages 24114-24133.

[2] EPA-440/1-74-a, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steelmaking Segment of the Iron and Steel Manufacturing Point Source Category.

Pollutants	kg/kkg of Product (lb/1000 lb of Product) Iron Making Blast Furnace	 Ferromanganese Blast Furnace
Ammonia (N)	0.0535	0.4287
Cyanide (Total)	0.0078	0.1563
Phenols	0.0021	0.0208
Suspended Solids	0.0260	0.1043
pH (Units)	Within the range 6.0-9.0	

The proposed maximum daily effluent limitations are three times the average values presented above.

Rationale for Selecting Proposed BPT Limitations

A. Treatment System

As noted in Section VII, the Agency found that each of the components incorporated in the BPT model treatment system is presently in use at most blast furnace sites. Based on the widespread use of these components, the Agency concluded that the BPT model treatment system is appropriate.

B. BPT Justification

Table IX-2 presents the effluent discharges for ironmaking operations sampled by the Agency or for which D-DCP responses were received. The only plants which did not comply with the proposed BPT limitations are those which either had a once-through treatment system or could not be fully evaluated due to the nature of the system. Although, some of these plants employ alkaline chlorination which aids in cyanide, ammonia, and phenols treatment, the data indicate that the proposed BPT effluent limitations for these pollutants can be attained by plants which do not employ alkaline chlorination. The sampled plants which are not included in Table IX-2, could comply with the proposed BPT limitations if they used recycle systems.

The BPT model treatment system does not represent the only means of attaining the proposed BPT effluent limitations. Other treatment systems, or components thereof, may be used as long as the proposed BPT limitations are attained.

C. Costs

Table VIII-5 presents a plant by plant summary of capital costs required to install the BPT model system. As shown, the total estimated capital cost of compliance with the proposed BPT limitations is about 122.3 million. The status of each plant was determined from DCP responses which described facilities in place as of January 1978. Since that time, however, many more blast furnaces have been retrofitted with BPT treatment systems and some older, uncontrolled furnaces have been permanently shut down. Based upon a telephone survey conducted by EPA during June 1980, and the data presented in Table VIII-5, the Agency estimates that about 21.91 million remains to be spent or committed by the industry to achieve full compliance with the proposed BPT limitations. All costs are in July 1, 1978 dollars.

TABLE IX-1
RAW WASTEWATER CHARACTERISTICS
IRONMAKING SUBCATEGORY

(All values expressed in mg/l unless otherwise noted)

	IRONMAKING BLAST FURNACES(1)	FERROMANGANESE BLAST FURNACE(2)
FLOW (gal/ton)	3200	11,540
AMMONIA (as N)	10	711
CYANIDE (Total)	10	692
PHENOLS	2.5	6.5
SUSPENDED SOLIDS	1900	4160
pH (Units)	6-10	8.8-11.3

(1) Raw wastewater quality reflects the discharge of a once-through system. Certain values would be increased as a result of the incorporation of recycle.

(2) Data is based on the one plant (no longer in operation) which was operational at the time of sampling. These values reflect the increases due to recycle.

TABLE IX-2

JUSTIFICATION OF BPT EFFLUENT LIMITATIONS IRONMAKING SUBCATEGORY

	Ammonia (as N)	Cyanide (T)	Phenols	TSS	pH	C&TT Components
Ironmaking Blast Furnaces						
Proposed BPT	0.0535	0.0078	0.0021	0.0260	6.0-9.0	T,FLP,VF,CT, RTP-96
Plants						
[illegible]	[illegible]	0.000173	[illegible]	NJ	7.6	T,CLA,SS, Filters,RTP-97
[illegible]	NJ	0.00724	0.000015	[illegible]	6.7-8.1	T,CT,SL,RTP-97 ES
[illegible] (0060F)	0.0356	0.00468	0.000004	0.0199	8.0	T,FLP,CT,VF, RTP-97,ES
026 (0112D)	0.0133	0.000015	0.000009	0.0215	7.3-7.5	T,FLP,VF,NA, CT,RTP-95
028 (0684H)	0.0125	0.000178	0.00157	NJ	8.2-8.8	A,CLA,FLP,CL, CT,FLFC,NA, RTP-92
030 (0112)	0.0437	0.00666	0.000066	0.0174	7.2-7.5	T,FLP,NA,VF, CT,RTP(Unk)
0684H(1)	0.0117	0.000750	NA	0.0161	8.6	A,NL,FLP, CLA,CL,VF,CT
Ferromanganese Blast Furnaces						
Proposed BPT	0.4287	0.1563	0.0208	0.1043	6.0-9.0	See comments in Section IX.
Plants						
025 (0112C)	No discharge of process wastewater pollutants.					CL,T,VF, CT,RTP-100

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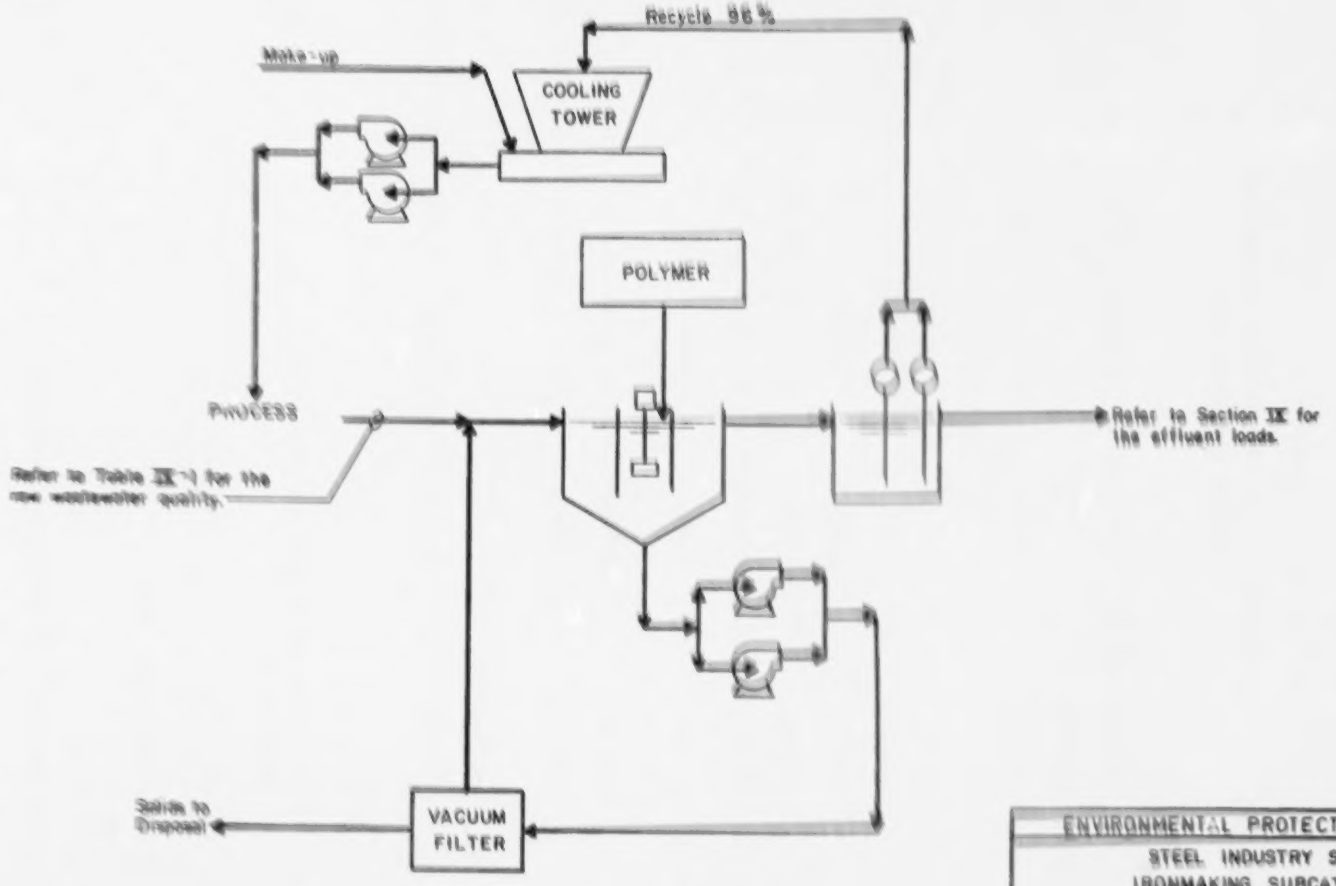
(1) Based on D-DCP analytical data
NA: No analysis
NJ: Not justified

NOTE: For definitions of C&TT Codes, see Table VII-1.


Make-up
COOLING TOWER
Recycle 96%
POLYMER
PROCESS
Refer to Table IX-1 for the raw wastewater quality.
Refer to Section IX for the effluent loads.
VACUUM FILTER
Solids to Disposal

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
BPT TREATMENT MODEL

Dwn 5/31/78
Rev 7/25/79

FIGURE IX-1

IRONMAKING SUBCATEGORY

SECTION X

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

This section identifies the five BAT alternative treatment systems, and the respective effluent discharge flow rates and pollutant levels considered by the Agency in developing the proposed BAT effluent limitations. Since there are no ferromanganese blast furnaces in operation or scheduled for operation, and since ferroalloy production is now confined to "submerged" electric furnaces, the Agency is not proposing BAT effluent limitations for ferromanganese blast furnaces. Should any ferromanganese blast furnaces operate, appropriate BAT effluent limitations should be established on a case by case basis using "best professional judgment" considering the BPT and BAT treatment systems contained herein for iron blast furnaces. The technologies incorporated in the BAT alternative treatment systems are capable of attaining similar pollutant effluent levels for both iron and ferromanganese blast furnace operations. However, for the BAT model treatment system, operating costs for ferromanganese treatment systems are likely to be higher due to higher levels of ammonia (N) and total cyanide in ferromanganese wastewaters.

Identification of BAT

Based upon the information presented in Sections III through VIII, the Agency developed the following treatment technologies (as add-ons to the BPT treatment system model) as BAT alternative treatment systems in the ironmaking subcategory.

BAT Alternative No. 1

The blowdown flow is reduced by tighter recycle of the BPT model treatment system to the point where it can be consumed in the quenching (cooling) of blast furnace slag. As all of the blowdown is evaporated, no process wastewater pollutants are discharged into navigable waters.

BAT Alternative No. 2

A reduced blowdown flow (70 gal/ton) is treated using filtration technology. Pressure filters are used to reduce toxic metals levels (as a result of removing suspended solids in which the toxic metals are entrained) in the blowdown. In addition, the filters reduce the levels of other pollutants which are entrained in the suspended solids.

BAT Alternative No. 3

Additional treatment of the reduced blowdown flow (70 gal/ton) is provided by adding a sulfide source to the wastewater prior to the filtration step described above. The addition of sulfide enhances the removal of toxic metals by forming metal sulfide precipitates which are subsequently removed by filtration.

BAT Alternative NO. 4

Lime addition and alkaline chlorination are added to the model treatment system (BAT No. 2) prior to filtration. Alkaline chlorination is used to oxidize (in stages) cyanides, phenols, and other organics present in the wastewaters and also to provide almost complete removal of ammonia. A clarifier is included to reduce the levels of suspended solids generated by the use of lime prior to filtration. The clarifier underflow is pumped to the vacuum filter (a component of the BPT model treatment system). The pH of the clarifier effluent is adjusted to the neutral range by the controlled addition of acid. The wastewaters then flow to the filters. The filter effluent is dechlorinated with appropriate reducing agents prior to discharge.

BAT Alternative No. 5

Additional treatment of the effluent from BAT Alternative No. 4 is provided by adsorption on activated carbon. Activated carbon will adsorb residual levels of toxic organic pollutants which may be present in the wastewater.

The treatment technologies described above are in full scale use in one or more blast furnace wastewater treatment systems, or demonstrated on the basis of pilot plant studies in this subcategory. The applicability of each treatment system is reviewed below.

The pollutants which were selected for limitation at the BAT level are presented in Table X-1. The Agency's selection of pollutants for which limitations are proposed is based upon the following considerations: the relative level, load, and environmental impact of each pollutant; the need to establish practical monitoring requirements; and, the ability of the selected pollutants to serve as "indicator" pollutants (see Section V of Volume I).

Treatment for the selected pollutants will generally result in a similar or greater degree of treatment for pollutants chemically related to the selected (indicator) pollutants and found at lower levels. For example, ten metals were identified in the process wastewaters from blast furnace operations at concentrations greater than 0.010 mg/l. However, the Agency is proposing BAT limitations for only lead and zinc. Significant removal of the other metals will occur in conjunction with the treatment and control of these metals. Similarly, a reduction in total cyanide and phenols in blast furnace wastewaters indicates a reduction in the levels of other toxic organic pollutants. For that reason, phenols (4-AAP method) was selected as an "indicator" pollutant for other toxic organic pollutants. Those toxic organic pollutants chemically unrelated to phenols are not addressed as they are present in ironmaking wastewaters at levels at or near the limits of treatability.

Rationale for the Selection of BAT

The Agency's rationale for selecting the proposed BAT model treatment system, for determining effluent flow rates, and for determining the concentrations of the regulated pollutants is reviewed below.

Treatment Technologies

Recirculation of treated wastewater is one of the major components of the BAT model treatment system. The recirculation rate of the BPT model treatment system is tightened from 96% (125 gal/ton) to 98% (70 gal/ton blowdown). Recycle of blast furnace wastewaters is a practice which is widely demonstrated in the industry. The 70 gal/ton blowdown rate has been demonstrated and is discussed in more detail below. In the first alternative, the blowdown is reduced to the point where it can be consumed to quench (cool) slag. Approximately 60% of the blast furnaces have adjacent slagging operations. This alternative provides an inexpensive approach to achieving the proposed BAT limitations. This practice is demonstrated at several plants. Filtration is currently used at two blast furnace operations and a filtration system is being installed at a third. Sulfide addition is demonstrated in the metals industry on similar wastewaters and is transferrable to this subcategory. Alkaline chlorination is used in several blast furnace wastewater treatment systems. The primary purpose of alkaline chlorination is the oxidation of cyanide, phenolics, and other toxic organic pollutants, as well as the removal of ammonia. The fifth BAT alternative uses activated carbon for the removal of residual levels of organics. No ironmaking wastewater treatment systems currently employ activated carbon treatment. However, at this writing, a full scale system is being installed to treat blast furnace blowdown. Pilot plant data from this site have been reviewed by the Agency.

Flows

The Agency has retained the applied flow of 13,344 l/kkg (3200 gal/ton) developed for the BPT model treatment system for use in the BAT alternative treatment systems. The discharge flow of 292 l/kkg (70 gal/ton) for the BAT model recirculation system is based primarily on wastewater treatment operations at plant 0112. A summary of long-term data obtained by the Agency for this plant demonstrates that the model effluent flow of 70 gal/ton is achievable. These data represent averages of daily flow measurements.

Month/Year	Monthly Average Discharge Flow (gal/ton)
4/78	91
5/78	64
6/78	69
7/78	82
8/78	68
9/78	63
10/78	52
11/78	51
12/78	38
1/79	85
2/79	128
3/79	53
Average	70.3

It should be noted that the above data cover a period of 12 consecutive months (thus encompassing all seasons). Based on the above long-term effluent flow data, the Agency has concluded that the BAT model treatment system discharge flow is appropriate. Also, flow data for Plant 0528A during the period January 1978 through December 1979 demonstrate an average blowdown rate of 66 gal/ton, thus providing additional support for the flow used to develop the proposed BAT limitations.

Wastewater Quality

The average and maximum effluent concentrations incorporated in each BAT treatment alternative are presented in Table X-1. The development of these effluent levels is discussed below.

BPT Regulated Pollutants

In the 1974 BPT regulation, the Agency established limitations for ammonia, cyanide, and phenols. Following is a discussion of the BAT treatment levels proposed for these pollutants. The discussions of toxic metal and organic pollutant treatment levels follows.

Cyanide effluent levels in BAT Alternatives Nos. 2 through 5 take into account the treatment accomplished by filtration and alkaline chlorination. The effects of the former are incorporated in BAT Nos. 2 through 3, while the effects of both are incorporated in BAT Nos. 4 through 5. No pollutant effluent levels are considered for BAT No. 1 as no process wastewater pollutants are discharged to navigable waters with this alternative. The cyanide effluent levels developed for BAT Alternative Nos. 2 and 3 are demonstrated not only by the sampled plant and long-term effluent analytical data provided in Section VII for several plants, but also by the long-term data provided in Table VII - 9.

The Agency's analysis of the capabilities of alkaline chlorination technology, with respect to the destruction of cyanide in process wastewaters, was primarily based upon the results obtained from pilot studies conducted at two blast furnace sites. The data for one of these pilot studies are presented in Table X-2. While this pilot study also incorporated activated carbon treatment in its system, alkaline chlorination is the process which destroys cyanide. In the other pilot study, the average influent cyanide (total) concentration of more than 3.0 mg/l was treated by alkaline chlorination to an average effluent concentration of less than 1.0 mg/l.

As noted previously, the various treatment technologies were shown to be capable of treating wastewaters of varying cyanide concentrations to similar effluent levels. This conclusion is supported by data from the sampled plant, D-DCPs, and pilot study analytical data. On this basis, BAT technologies and cyanide effluent levels are demonstrated as being applicable to all blast furnace operations. Additional support for the cyanide effluent levels incorporated in BAT alternative Nos. 4 and 5 is also provided in the D-DCP long-term effluent analytical data presented in Table VII-7. Based upon the factors and data noted above, the Agency concludes that cyanide effluent limitations contained in the BAT alternatives are supported and are appropriate.

The effluent levels for phenols in alternatives 2 and 3 are based upon performance of existing blast furnace recycle systems as the technologies included in these alternatives are not credited with any phenols removal capabilities. In BAT No.4, the Agency believes that alkaline chlorination is capable of achieving significant reductions in effluent phenol levels. The capabilities of this technology, with respect to phenols treatment, are demonstrated in the sampled plant and D-DCP (long-term) analytical data and in the results of the pilot studies noted above. The results for the pilot study noted on Table X-2 do not address the phenol treatment capabilities of alkaline chlorination alone. In the other pilot study, a treatment system which includes alkaline chlorination produced an average phenols effluent level less than 0.10 mg/l (while the average phenols influent concentration was greater than 4.0 mg/l). The phenols removal capabilities of BAT No. 5 are discussed in further detail in the Toxic Organic Pollutants discussion which follows.

Ammonia (N) levels are effectively reduced by the alkaline chlorination and associated treatment technologies incorporated in BAT Nos.4 and 5. The ammonia (N) effluent levels for these alternatives are based upon the pilot study data noted above. In one of these pilot studies, alkaline chlorination technology achieved an average ammonia (N) effluent level of less than 1.0 mg/l while the average influent concentration was greater than 50 mg/l. The data for the other pilot study is presented on Table X-2. While this latter study also incorporated activated carbon treatment technology, this technology does not have a significant ability to remove ammonia.

The pH adjustment and dechlorination steps have been positioned in the model treatment systems to achieve virtually complete cyanide destruction and optimum ammonia oxidation. The location of the pH adjustment step in the treatment scheme insures that sufficient reaction time is available to convert the cyanates to carbon dioxide and nitrogen.

Toxic Metals Pollutants

The following discussions relate to the filtration, and lime and sulfide precipitation treatment technologies as they are the BAT treatment system components designed to control toxic metals.

The Agency reviewed long-term filtration system effluent analytical data to determine the toxic metals removal capabilities of filtration systems (BAT-2) used in similar wastewater treatment applications. The data indicate that the majority of the toxic metals load is in the particulate form and can be removed with the suspended solids. In those instances in which the long-term data (noted above and discussed in Volume I) are for ironmaking process wastewater filtration applications, toxic metals removals are generally based upon the degree of suspended solids removal accomplished. The sampled plant analytical data presented in Section VII demonstrates this general pattern, although the toxic metals effluent concentrations are generally slightly higher than the levels expected strictly on the basis of the metal/TSS ratio. Sedimentation and filtration do not have a significant effect on that portion of the toxic metals dissolved in process wastewaters (a minor portion of the toxic metals total raw waste load). Additional details regarding dissolved metals are presented below. The toxic metals effluent levels incorporated at BAT, which are based on total concentrations, are supported by the sampled plant and D-DCP effluent analytical data presented in Section VII. In addition, pilot studies in the steelmaking subcategory were also used to determine the treatment capabilities of the various technologies as they pertain to the removal of toxic metals. Refer to Appendix A of Volume I for the details of these studies. The Agency concluded that ironmaking and steelmaking process wastewaters are sufficiently similar that this pilot study data could be used (along with other data) in determining the performance of various technologies with respect to the removal of toxic metals from ironmaking wastewaters. Maximum effluent concentrations for the toxic metals are set at three times the average monthly concentration based upon the data review detailed in Volume I.

In order to remove dissolved toxic metals and thus attain the highest practical degree of toxic metal removal, the Agency considered lime precipitation (BAT Alternatives 4 and 5) and sulfide addition (BAT Alternative 3) in conjunction with filtration. The presence of dissolved toxic metals in ironmaking wastewaters is related to the nature of the process itself (some of the volatilized metals, e.g., zinc, are not entirely transformed to oxides) and to the amphoteric nature of some of the toxic metals (primarily zinc) which results in the dissolution of these metals at higher pH levels. It should be noted that ironmaking process wastewaters are typically alkaline. In fact, a number of plants employ acid addition as a means of controlling the pH of their recycled wastewaters. While the Agency did not find sulfide precipitation technology in use at any ironmaking process, the capabilities of this technology with respect to toxic metals precipitation have been demonstrated in the steelmaking subcategory pilot studies noted above and in other industries. The toxic metals effluent levels which can be achieved with this treatment technology were developed on the basis of the data review presented in Volume I.

The toxic metals effluent levels which can be achieved by lime precipitation, sedimentation, and filtration techniques were determined on the basis of a review of sampled plant analytical data in this subcategory and of pilot study data in the steelmaking subcategory.

As noted above, sulfide addition was first considered as a means of further reducing the loadings of toxic metals. However, since this technology has not been demonstrated in this subcategory, and due to potential operating problems and the marginal incremental metals removal, the Agency concluded that sulfide precipitation (for the purpose of reducing toxic metals effluent levels) should not be a BAT model treatment technology. However, the addition of sulfide or other suitable reducing agents can be used to effectively control excess residual chlorine following alkaline chlorination. Hence, the cost for dechlorinating at BAT (BAT-4 and BAT-5) was based upon sulfide addition.

Toxic Organic Pollutants

The removal of most toxic organic pollutants, primarily phenolic compounds, is accomplished in BAT Alternative No. 4 (alkaline chlorination), although activated carbon treatment in BAT No. 5 is designed specifically to remove residual levels of those toxic organic pollutants which may be present after treatment in BAT No. 4. It must be noted that, with the exception of phenol and some of its related compounds, ironmaking wastewaters contain few detectable toxic organic pollutants after alkaline chlorination and that those organics are present at only low concentrations. In consideration of the above observations, the Agency has decided to use phenolic compounds as an indicator of the degree of toxic organic pollutants treatment achieved in BAT No. 4 and BAT No. 5.

The treatment capabilities of activated carbon are based on pilot plant studies, sampling data from a coke plant full-scale operation and literature which predicted treatment performance. The analytical data from a blast furnace wastewater treatment pilot plant study are presented on Table X-2. This pilot treatment system included alkaline chlorination and activated carbon treatment components. The data provided by this study support the attainability of the effluent concentration for phenols incorporated in BAT No.5. In fact, the maximum phenols effluent concentration observed in this study was less than the average value incorporated in BAT No.5. Another blast furnace wastewater treatment pilot study, which investigated the same treatment technologies, achieved an average phenols effluent concentration of less than 0.05 mg/l with activated carbon. The data presented in Volume I also support the applicability of the phenols effluent level incorporated in BAT No.5. A major source of data in the Volume I review was a coke plant wastewater treatment system. It should be noted that many of the toxic organic pollutants found in ironmaking process wastewaters are also found in coke plant process wastewaters. This similarity can be related to the use of large quantities of coke in the ironmaking process. For the reasons noted previously in this section, the Agency believes that the technology and effluent levels discussed above are applicable to all blast furnace operations. As with the other pollutants discussed in this section, maximum phenols effluent concentrations are twice the average effluent concentrations.

Total Residual Chlorine

A total residual chlorine limitation of 0.5 mg/l daily maximum is included in BAT Nos. 4 and 5 to control excess chlorine resulting from alkaline chlorination. Various sulfide compounds can be employed to destroy excess chlorine. The chemistry of this reaction is well documented throughout the literature and the technology is well demonstrated in other industries.

Effluent Limitations for BAT Alternatives

The effluent limitations for the BAT alternative treatment systems were developed on a mass basis (kg/kkg or lbs/1000 lbs) by considering the model plant effluent flow (70 gal/ton) and the respective BAT treated effluent concentrations. Effluent limitations, presented in Table X-1 for each treatment alternative are on a mass basis; any combination of effluent flows and concentrations which attain the specified mass limitations is satisfactory.

Selection of a BAT Alternative

The Agency selected BAT Alternative No. 4 as the basis for the proposed BAT limitations. The selection process included a review, among other factors, of the treatability of the toxic pollutants considered for limitation, the effluent levels of these pollutants in each treatment alternative, and the annual costs of each alternative. On the basis of these considerations, the Agency determined that BAT No.4 provided the most significant benefits with respect to the control of toxic pollutant effluent loads. The pollutants of major concern are phenols, cyanide, metals, and ammonia (N). As can be seen in the summary of BAT effluent qualities (Table X-1), the effluent levels of most of these pollutants are reduced only at BAT No.4. Since chlorinated organics have not been found at any substantial degree and are apparently not formed by alkaline chlorination of blast furnace blowdowns, the activated carbon step included in BAT No. 5 is not necessary. The Agency concludes that the effluent reduction benefits associated with alkaline chlorination of blast furnace wastewaters justify the negative aspects of the generation of low levels of brominated compounds.

While BAT No.1 is the least expensive alternative and achieves the highest degree of treatment (i.e., no discharge of process wastewater pollutants to navigable wasters), the Agency concludes that this alternative cannot serve as the basis for BAT effluent limitations for the entire subcategory. Due to the methods of slag handling (i.e., remote from the blast furnace) some plants cannot employ this technology. However, as noted in Section VIII, the Agency believes that BAT No.1 may be selected by many plants as the least expensive means of meeting BAT requirements. Approximately 60% of the plants employ slagging operations adjacent to the blast furnaces, and in those instances the Agency believes that evaporation on slag can be employed to meet the proposed limitations.

TABLE X-1

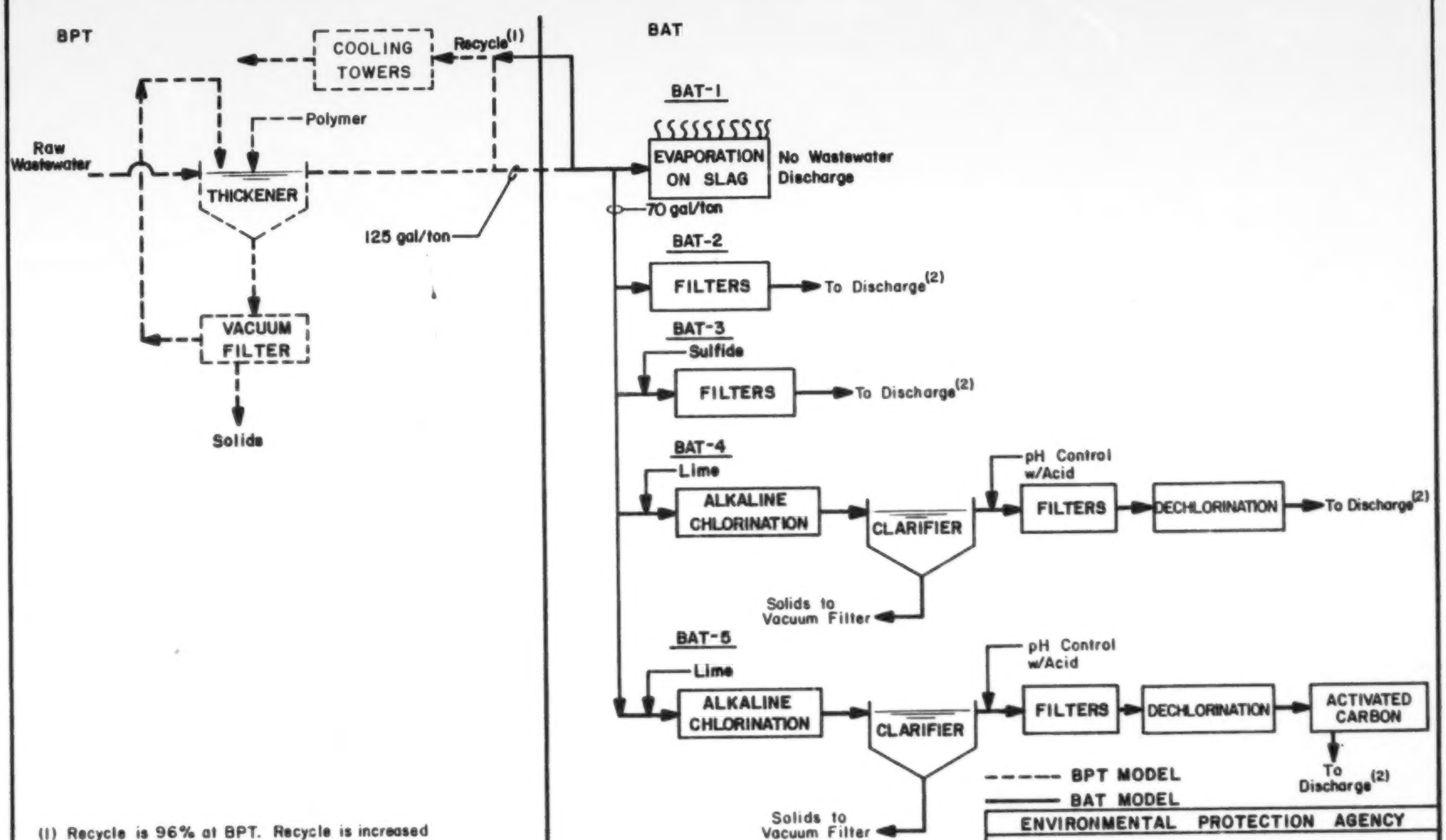
BAT EFFLUENT LEVELS AND LOADS
IRONMAKING SUBCATEGORY

	Alternative No.1		Alternative No.2		Alternative No.3		Alternative No.4		Alternative No.5	
	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l
Ammonia (as N)										
Average	–(1)	–	0.0146	50	0.0146	50	0.000292	1.0	0.000292	1.0
Maximum	–	–	0.0292	100	0.0292	100	0.000584	2.0	0.000584	2.0
Cyanide (T)										
Average	–	–	0.000730	2.5	0.000730	2.5	0.000292	1.0	0.000292	1.0
Maximum	–	–	0.00146	5.0	0.00146	5.0	0.000584	2.0	0.000584	2.0
Phenols										
Average	–	–	0.000876	3	0.000876	3	0.0000292	0.10	0.0000146	0.05
Maximum	–	–	0.00175	6	0.00175	6	0.0000584	0.20	0.0000292	0.10
Chlorine (Residual)										
Maximum	–	–	–	–	–	–	0.000146	0.5	0.000146	0.5
Lead										
Average	–	–	0.0000876	0.30	0.0000438	0.15	0.0000730	0.25	0.0000730	0.25
Maximum	–	–	0.000263	0.90	0.000131	0.45	0.000219	0.75	0.000219	0.75
Zinc										
Average	–	–	0.00131	4.5	0.0000730	0.25	0.0000876	0.30	0.0000876	0.30
Maximum	–	–	0.00394	13.5	0.000219	0.75	0.000263	0.90	0.000263	0.90
Flow										
l/kkg	–	–		292		292		292		292
gal/ton	–	–		70		70		70		70

---

(1) Alternative No. 1 accomplishes no discharge of process wastewater pollutants to navigable waters.
(2) kg/kkg (lb/1000 lb) of product.

NOTE: Proposed BAT effluent limitations are based upon BAT Alternative No. 4, the selected alternative.


BPT
BAT
COOLING TOWERS
Recycle(1)
Polymer
Raw Wastewater
THICKENER
125 gal/ton
VACUUM FILTER
Solids
BAT-1
EVAPORATION ON SLAG
No Wastewater Discharge
70 gal/ton
BAT-2
FILTERS
To Discharge(2)
BAT-3
Sulfide
FILTERS
To Discharge(2)
BAT-4
Lime
ALKALINE CHLORINATION
CLARIFIER
pH Control w/Acid
FILTERS
DECHLORINATION
To Discharge(2)
Solids to Vacuum Filter
BAT-5
Lime
ALKALINE CHLORINATION
CLARIFIER
pH Control w/Acid
FILTERS
DECHLORINATION
ACTIVATED CARBON
To Discharge(2)
Solids to Vacuum Filter
BPT MODEL
BAT MODEL

(1) Recycle is 96% at BPT. Recycle is increased to 98% at BAT.

(2) Refer to Table X-1 for effluent quality and loads.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
BAT TREATMENT ALTERNATIVES

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FIGURE X-1

IRONMAKING SUBCATEGORY

SECTION XI

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY (BCT)

INTRODUCTION

The 1977 Amendments added section 301(b)(4)(E) to the Act, establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(b)(4) - BOD, TSS, fecal coliform and pH - and any additional pollutants defined by the Administrator as "conventional." On July 28, 1978, EPA proposed that COD, oil and grease, and phosphorus be added to the conventional pollutant list (43 Fed. Reg. 32857). However, only oil and grease was added.

BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. BCT requires that limitations for conventional pollutants be assessed in light of a new "cost-reasonableness" test, which involves a comparison of the cost and level of reduction of conventional pollutants from the discharge of POTWs to the cost and level of reduction of such pollutants from a class or category of industrial sources. As part of its review of BAT for certain "secondary" industries, EPA proposed methodology for this cost test. (See 43 Fed. Reg. 37570, August 23, 1978).

Development of BCT

The reference POTW treatment cost for the conventional pollutants is $1.34/lb. The detailed results of the BCT Cost Test are presented in Table VIII-7. A summary of these results is presented below.

BCT Alternative	BCT Cost Test Results
BCT-1 (based on BAT-1)	$0.35/lb
BCT-2 (based on BAT-2 and 3)	$0.63/lb
BCT-3 (based on BAT-4 and 5	$1.08/lb

The BCT alternative treatment systems and associated BCT treatment components are illustrated in Figure XI-1. As can be seen above, the BCT costs for all of the alternatives are less than the reference POTW treatment costs; therefore, these alternatives pass the BCT Cost Test.

Development of BCT Limitations

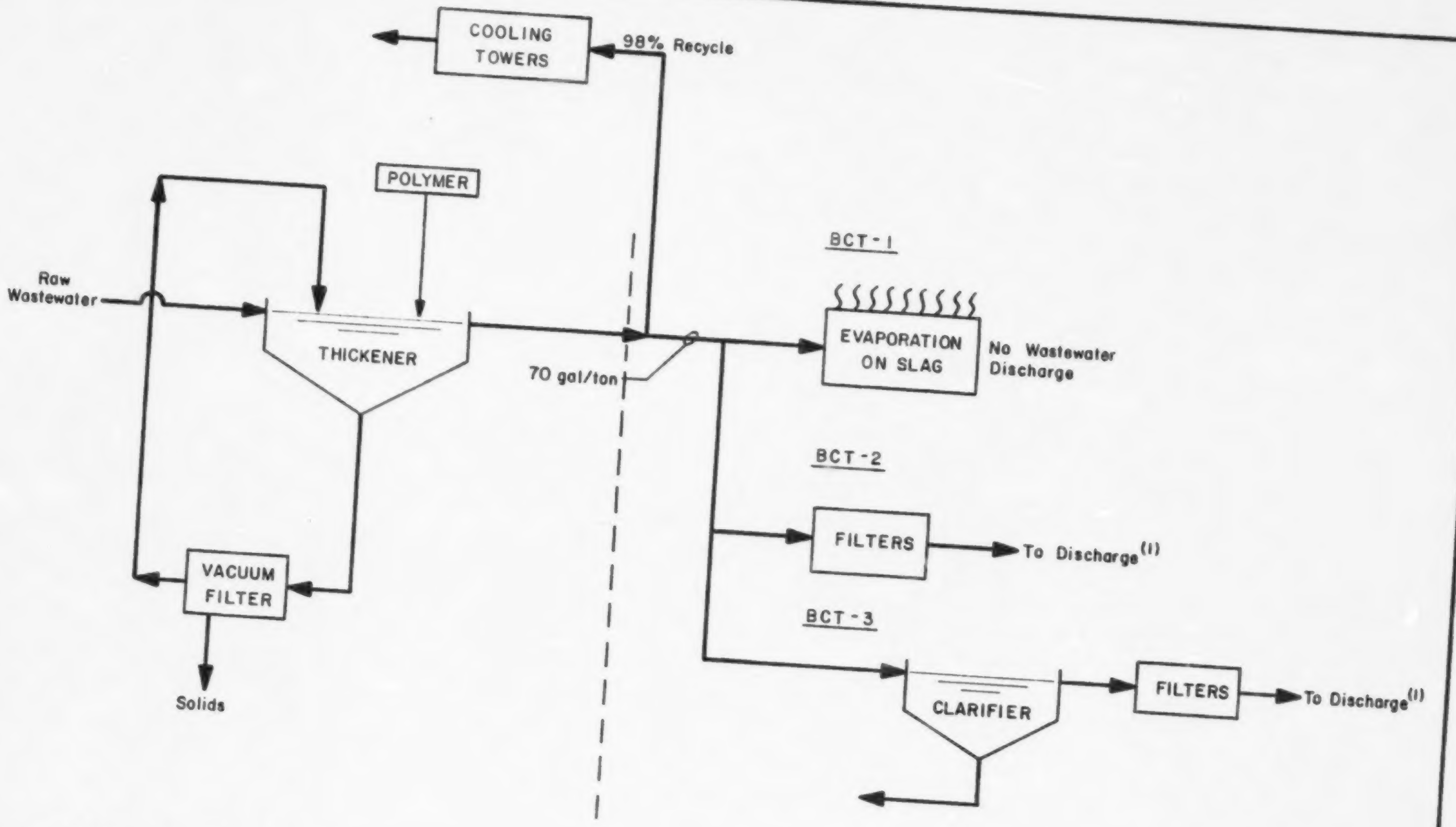
The effluent level of 15 mg/l for suspended solids in each of the treatment models was based on a statistical review of long-term analytical data supplied by the industry for several wastewater filtration systems. The particulate matter suspended in ironmaking process wastewaters exhibits behavior similar to the solids in the wastewater noted above. Refer to Volume I for a detailed review of the determination of thirty day average and daily maximum effluent concentrations.

Further support for the effluent level incorporated at BCT is provided in Table VII-9 which includes long-term analytical data provided for Plant 0860B, a relatively tight recycle system. Although this plant does not have a filtration system, it demonstrates the achievability of the effluent level noted above. This limitation is also supported by pilot studies (including filtration) conducted at another plant.

As noted in Volume I, the effluent limitations for central treatment systems will be equal to the sum of limitations for each pollutant in each subcategory. Ironmaking and sintering wastewaters are co-treated at several plants. In the interest of establishing compatible effluent limitations for the ironmaking and sintering subcategories, the Agency is proposing a BCT limitation for oil and grease for the ironmaking subcategory. This proposed limitation is based upon the application of the concentration value developed for the sintering BCT level of treatment to the ironmaking treatment model effluent flow.

The proposed BCT effluent limitations for the ironmaking subcategory are presented below:

		Proposed BCT Effluent Limitations (kg/kkg of Product)
Suspended Solids -	Ave.	0.0044
	Max.	0.0117
ph (Units)		within the range 6.0 to 9.0
Oil and Grease -	Max.	0.0029


COOLING TOWERS
98% Recycle
POLYMER
Raw Wastewater
THICKENER
70 gal/ton
VACUUM FILTER
Solids
BCT-1
EVAPORATION ON SLAG
No Wastewater Discharge
BCT-2
FILTERS
To Discharge(1)
BCT-3
CLARIFIER
FILTERS
To Discharge(1)

(1)- Refer to Table XI-1 for the effluent quality and loads.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
BCT TREATMENT MODELS

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FIGURE XI-1

IRONMAKING SUBCATEGORY

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS

Introduction

A new source is defined as any source constructed after New Source Performance Standards (NSPS) are proposed. NSPS effluent limitations are based upon effluent quality achievable through the application of Best Available Demonstrated Control Technology (BADCT), processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.

Identification of NSPS

The five alternative treatment systems developed for NSPS, shown in Figure XII-1, are the same as the BPT and respective BAT alternative treatment systems. The corresponding effluent standards for these treatment alternatives are presented in Table XII-1. Following is a summary of the treatment technologies incorporated in each NSPS treatment alternative:

NSPS No. 1 - Gravity sedimentation in a thickener, coagulant aid addition, vacuum filtration of solids, recycle through a cooling tower, and evaporation of the blowdown on slag.

NSPS No. 2 - Same as the above with the exception of evaporation on slag. The recycle system blowdown undergoes filtration.

NSPS No. 3 - Sulfide addition is incorporated prior to the filtration step of NSPS No. 2.

NSPS No. 4 - Alkaline chlorination is incorporated prior to the clarification step of NSPS No. 3. The pH of the clarifier effluent is then adjusted to the neutral range by the controlled addition of acid. Dechlorination is incorporated as the final treatment step.

NSPS No. 5 - Activated carbon adsorption is provided as the final treatment step.

Rationale for Selection of NSPS

As the NSPS treatment alternatives are identical to the BPT, BAT, and BCT treatment systems, the rationale presented in Sections IX, X, and XI for these systems is applicable to NSPS.

All of the NSPS treatment schemes are addressed collectively below.

Treatment Technologies

As noted in previous sections, the technologies incorporated in the NSPS alternative treatment systems are demonstrated within the ironmaking subcategory or transferred from other subcategories or related industries (as discussed in Section X). Therefore, the recommended treatment technologies are applicable to NSPS for ironmaking wastewaters.

The resulting effluent wastewater qualities for the NSPS treatment alternatives are presented in Table XII-1. As noted in Sections X and XI, the critical pollutants and their effluent levels were based upon the demonstrated capabilities of the various wastewater treatment technologies.

Another available technology is nonevaporative cooling of blast furnace wastewaters. This system has the potential for extremely low blowdown rates, or, possibly, zero discharge. This technology is installed at one plant and is currently being installed at others.

Flows

The applied and discharge flows developed for BPT and BAT are applicable, as well, to all NSPS treatment alternatives. As noted in Section X, the treatment model effluent (blowdown) flow of 70 gal/ton has been demonstrated on the basis of long-term operational data. In addition, the treatment model recycle rate of 98% (as defined by the model applied and discharge flow rates) is also demonstrated in the ironmaking subcategory.

Selection of an NSPS Alternative

The Agency selected NSPS No. 4 as the NSPS model treatment system upon which the proposed NSPS effluent standards are based. This alternative was selected for the same reasons noted in the discussion presented in Section X regarding the selection of the BAT model treatment system. As noted for BAT, evaporation of the recycle system blowdown to extinction on slag is a satisfactory means of attaining the proposed NSPS, which are noted on Table XII-1 under the heading of NSPS No. 4.

TABLE XII-1

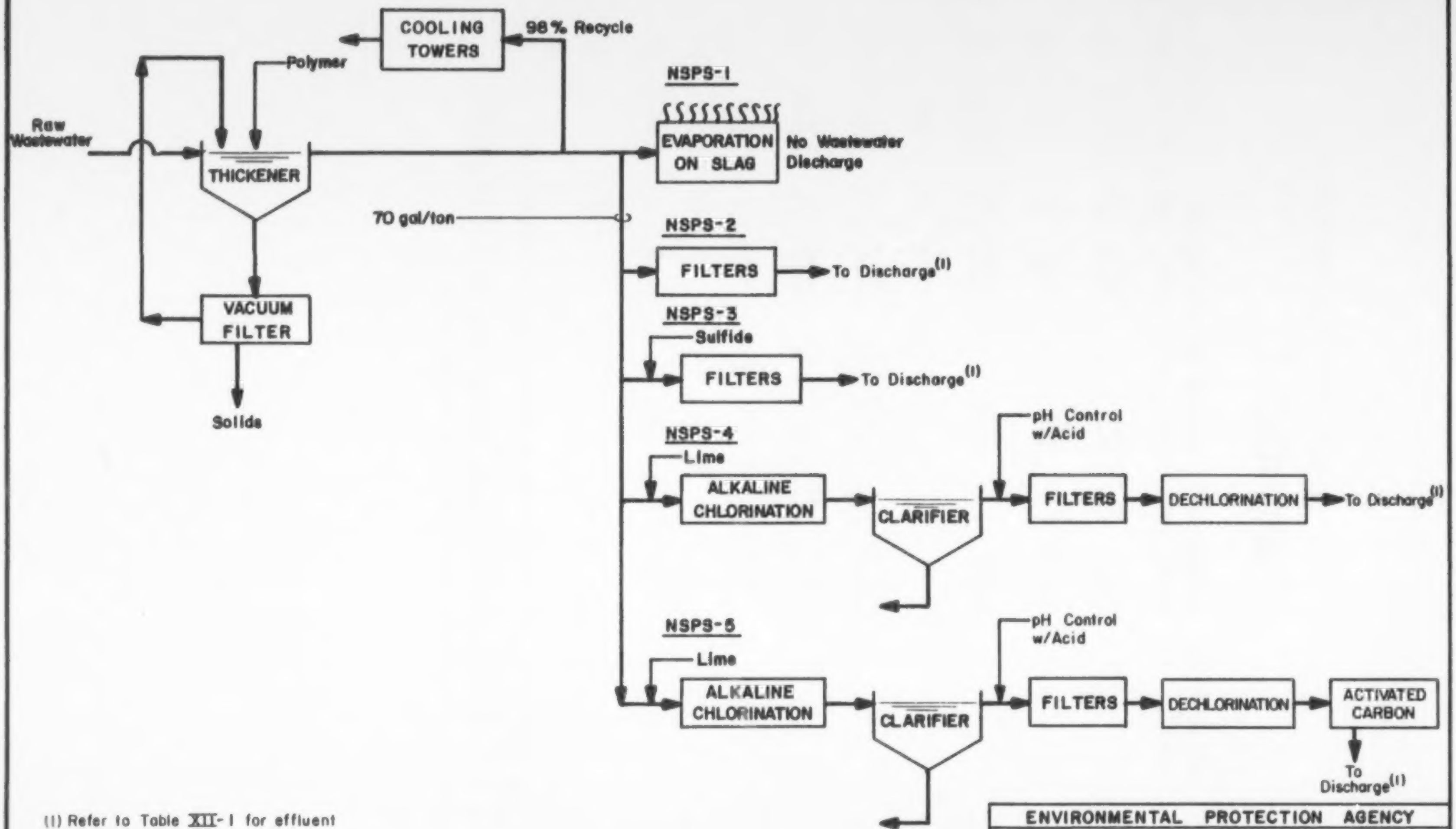
NSPS - EFFLUENT LEVELS AND LOADS
IRONMAKING SUBCATEGORY

	Alternative No.1		Alternative No.2		Alternative No.3		Alternative No.4		Alternative No.5	
	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l
Ammonia (as N)										
Average	-(1)	-	0.0146	50	0.0146	50	0.000292	1.0	0.000292	1.0
Maximum	-	-	0.0292	100	0.0292	100	0.00058	2.0	0.000584	2.0
Cyanide (T)										
Average	-	-	0.000730	2.5	0.000730	2.5	0.000292	1.0	0.000292	1.0
Maximum	-	-	0.00146	5.0	0.00146	5.0	0.000584	2.0	0.000584	2.0
Phenols										
Average	-	-	0.000876	3	0.000876	3	0.0000292	0.10	0.0000146	0.05
Maximum	-	-	0.00175	6	0.00175	6	0.0000584	0.20	0.0000292	0.10
Chlorine (Residual)										
Maximum	-	-	-	-	-	-	0.000146	0.5	0.000146	0.5
Lead										
Average	-	-	0.0000876	0.30	0.0000438	0.15	0.0000730	0.25	0.0000730	0.25
Maximum	-	-	0.000263	0.90	0.000131	0.45	0.000219	0.75	0.000219	0.75
Zinc										
Average	-	-	0.00131	4.5	0.0000730	0.25	0.0000876	0.30	0.0000876	0.30
Maximum	-	-	0.00394	13.5	0.000219	0.75	0.000263	0.90	0.000263	0.90
Suspended Solids										
Average	-	-	0.00438	15	0.00438	15	0.00438	15	0.00438	15
Maximum	-	-	0.0117	40	0.0117	40	0.0117	40	0.0117	40
pH	-	-		6-9		6-9		6-9		6-9
Oil & Grease(3)										
Maximum	-	-	0.00292	10	0.00292	10	0.00292	10	0.00292	10
Flow										
l/kkg	-	-		292		292		292		292
gal/ton	-	-		70		70		70		70

---

(1) Alternative No. 1 accomplishes no discharge of process wastewater pollutants to navigable waters.
(2) kg/kkg (lb/1000 lb) of product.
(3) Effluent limitations for oils and greases have been provided in recognition of the co-treatment options available to those plants with sintering and ironmaking operations. Refer to Section XI for details.

NOTE: Proposed NSPS are based upon NSPS Alternative No. 4, the selected alternative.


Raw Wastewater
Polymer
THICKENER
COOLING TOWERS
98% Recycle
VACUUM FILTER
Solids
70 gal/ton
NSPS-1
EVAPORATION ON SLAG
No Wastewater Discharge
NSPS-2
FILTERS
To Discharge(1)
NSPS-3
Sulfide
FILTERS
To Discharge(1)
NSPS-4
Lime
ALKALINE CHLORINATION
CLARIFIER
pH Control w/Acid
FILTERS
DECHLORINATION
To Discharge(1)
NSPS-5
Lime
ALKALINE CHLORINATION
CLARIFIER
pH Control w/Acid
FILTERS
DECHLORINATION
ACTIVATED CARBON
To Discharge(1)

(1) Refer to Table XII-1 for effluent quality and loads.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
NSPS TREATMENT MODELS

Dwn.5/12/80

FIGURE XII-1

IRONMAKING SUBCATEGORY

SECTION XIII

PRETREATMENT STANDARDS FOR DISCHARGES TO PUBLICLY OWNED TREATMENT WORKS

Introduction

This section discusses the alternative control and treatment systems alternatives available for blast furnace operations which discharge wastewaters to publicly owned treatment works (POTWs). The blowdowns from two ironmaking operations are discharged to POTWs. Separate consideration has been given to new and existing blast furnaces: Pretreatment Standards New Sources (PSNS) and Pretreatment Standards Existing Sources (PSES).

The general pretreatment and categorical pretreatment standards applying to ironmaking operations are discussed below.

General Pretreatment Standards

For detailed information on Pretreatment Standards refer to 43 FR 27736-27773, "General Pretreatment Regulations for Existing and New Sources of Pollution," (June 26, 1978). In particular, 40 CFR Part 403 describes national standards (prohibited and categorical standards), revision of categorical standards through removal allowances, and POTW pretreatment programs.

In establishing pretreatment standards for ironmaking operations, the Agency gave primary consideration to the objectives and requirements of the General Pretreatment Regulations. The General Pretreatment Regulations set forth general discharge prohibitions that apply to all non-domestic users of a POTW to prevent pass-through of pollutants, interference with the operation of a POTW, and municipal sludge contamination. The regulations also establish administrative mechanisms to ensure application and enforcement of prohibited discharge limits and categorical pretreatment standards. In addition, the Regulations contain provisions relating directly to the determination of and reporting on Pretreatment Standards.

POTWs are usually not designed to treat the toxic and nonconventional (i.e., ammonia) pollutants present in ironmaking process wastewaters. Instead, POTWs are designed to treat biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform bacteria, and pH. Whatever removal is obtained by POTWs for toxic pollutants is incidental to the POTW's main function of conventional pollutant treatment. POTWs have, historically, accepted large amounts of many pollutants well above their capacity to treat them adequately. As the issue of municipal sludge use has become more important, pretreatment standards must address toxic and nonconventional pollutant removal, rather than transfer these pollutants to POTWs where many pollutants concentrate in the sludges.

Preatreatment standards for TSS, oil and grease, and pH are not proposed because these pollutants, at the levels found after pretreatment in this subcategory, are compatible with POTW operations and can be effectively treated at POTWs.

Due to the presence of toxic and nonconventional pollutants in wastewaters from ironmaking operations, pretreatment must be provided to ensure that these pollutants do not interfere with, pass through, or otherwise be incompatible with POTW operations or damage the treatment facilities. The following discussions identify the pretreatment alternatives considered for toxic and nonconventional pollutant removal, the rationale for these technologies, and, finally, the selection of a pretreatment alternative upon which the proposed categorical PSES and PSNS are based.

Identification of Pretreatment Alternatives

The PSES and PSNS alternative treatment systems are identical to NSPS Alternatives Nos. 2, 3, and 4. Reference is made to Sections X and XII for a discussion of these treatment systems.

Following is a summary of the treatment components incorporated in each pretreatment alternative:

PSES and PSNS No. 1 -	Coagulant aid addition, gravity sedimentation in a thickener, vacuum filtration of sludges, recycle (98%) through a cooling tower, and filtration of the system blowdown.
PSES and PSNS No. 2 -	In addition to the components noted above, sulfide precipitation is incorporated prior to filtration.
PSES and PSNS No. 3 -	Alkaline chlorination and clarification are incorporated prior to the filtration component of PSES and PSNS No. 2. The pH of the clarifier effluent is then adjusted to the neutral range by the controlled addition of acid. As a final step, the filter effluent is dechlorinated.

The intent of the proposed categorical pretreatment standard is to provide reductions in the effluent levels of ammonia, cyanide, toxic metals, and toxic organic pollutants. Filtration and sulfide precipitation (in PSES and PSNS Nos. 1 and 2) are incorporated for the purpose of reducing toxic metals effluent levels. As noted in Section X, the major portion of the toxic metals waste load is entrained in the particulate matter suspended in the process wastewaters. Consequently, suspended solids control by sedimentation and filtration will result in the removal of a substantial portion of the toxic metals load. Sulfide or lime precipitation will provide additional toxic metals level and load reductions, as either or these technologies will precipitate quite effectively that portion of the toxic metals load dissolved in the process wastewaters. Alkaline chlorination technology is incorporated as a means of achieving removal of ammonia (N), cyanide, and phenols.

Figure XIII-1 illustrates the three pretreatment alternative systems described above. Table XIII-1 presents the effluent levels and loads for each alternative of those pollutants considered for regulation. As noted previously, the pretreatment systems are identical to NSPS Alternative Nos. 2, 3, and 4, therefore, reference can be made to the NSPS model cost data presented in Section VIII. No pretreatment effluent standards are proposed for suspended solids as this is a conventional pollutant which can be effectively treated by POTWs. However, suspended solids removal is an important factor in toxic metals control.

Rationale for the Selection of Pretreatment Technologies

The recycle rate incorporated in the pretreatment systems was justified in Section X. Recycle is needed in blast furnace pretreatment system discharges to POTWs in order to minimize the hydraulic impact of these discharges. Excessive flows to a POTW must be restricted not only for reasons of physical limitations (i.e. hydraulics), but also for reasons of process limitations. The pretreatment model effluent flow of 70 gal/ton is identical to that of the BAT and NSPS models.

As noted previously, the toxic metals present in ironmaking wastewaters are found primarily in the particulate matter, thus, control of suspended solids will produce a reduction in the toxic metals. In addition, precipitation technologies will facilitate optimum toxic metals level and load reductions by removing toxic metals which are dissolved in the process wastewaters. Toxic metals can adversely affect a POTW by inhibiting the normal biological oxidation process. In addition, toxic metals can pass through the POTW system and contaminate the POTW sludges.

It has been shown [3] that the toxic metals (particularly lead and zinc) found in blast furnace wastewaters, inhibit normal POTW biological processes when found at levels typical of ironmaking process wastewaters. The use of the treatment technologies described above insures that the levels of lead and zinc (and, consequently, the levels of other toxic metals) in ironmaking wastewater blowdowns will not adversely affect POTW treatment operations.

Other studies [4] have shown that from 50 to 90% of the toxic metals entering a POTW will pass through the system. Hence, POTWs could discharge undesireable levels of toxic metals when accepting industrial process wastewaters (e.g., ironmaking process wastewaters).

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[3] EPA-430/9-76-017a, Construction Grants Program Information; Federal Guidelines, State and Local Pretreatment Programs.

[4] Federal Register; Friday, September 7, 1979; Part IV, EPA Effluent Guidelines and Standards; Electroplating Point Source Category - pp. 52597-52601.

The toxic metals which do not pass through a POTW, are concentrated in POTW sludges. This build-up of toxic metals in sludges adversely affects sludge disposal. Sludges containing high concentrations of toxic metals and used as soil supplements could adversely affect plant growth and, more importantly, contaminate surface and groundwaters.

Unless a POTW is designed for nitrification, ammonia (N) will pass through a POTW system. As not all POTWs have nitrification treatment capabilities, and high ammonia levels and loads are typical of blast furnace process wastewaters, ammonia (N) control at PSES and PSNS is warranted. In the case of an ironmaking process wastewater pretreatment system, treatment to reduce ammonia (N) levels and loads is accomplished by alkaline chlorination and the associated treatment technologies (described previously). The key factors in applying these technologies are the adequacy of the chlorine feed and provisions for sufficient treatment capacity and reaction time. The discharge of significant ammonia (N) loads by a POTW, to a receiving stream, often results in stream ammonia (N) toxicity and in deoxygenation.

Alkaline chlorination, and its associated treatment components, are also incorporated in an ironmaking pretreatment alternative because of the demonstrated cyanide treatment capabilities of these components. It has been shown[3] that cyanide, at levels found in ironmaking wastewaters, can have an inhibitory effect on the POTW treatment process. Consequently, treatment for cyanide will insure that POTW treatment operations are not adversely affected. It was also found[4] that cyanide pass through averaged 70% in the POTWs studied. As with the toxic metals, the possibility exists that a POTW could discharge undersireable levels of cyanide.

In PSES and PSNS No. 3, phenols reduction occurs as a result of alkaline chlorination for the control of ammonia (N) and cyanides. However, most POTWs are capable of accepting and treating wastewaters containing phenols if proper waste equalization and acclimation are provided.

Selection of Pretreatment Alternative

On the basis of the considerations presented above (i.e., treatment for toxic metals, ammonia (N), and cyanide), PSES and PSNS Alternative No. 3 was selected as the alternative upon which the proposed PTS standards are based. The proposed standards noted in Table XIII-1 apply to all new and existing ironmaking operations discharging to POTWs.

TABLE XIII-1

PSES AND PSNS - EFFLUENT LEVELS AND LOADS IRONMAKING SUBCATEGORY

	Alternative No. 1		Alternative No. 2		Alternative No. 3	
	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l
Ammonia (as N)						
Average	0.0146	50	0.0146	50	0.000292	1.0
Maximum	0.0292	100	0.0292	100	0.000584	2.0
Cyanide (T)						
Average	0.000730	2.5	0.000730	2.5	0.000292	1.0
Maximum	0.00146	5.0	0.00146	5.0	0.000584	2.0
Phenols						
Average	0.000876	3	0.000876	3	0.0000292	0.10
Maximum	0.00175	6	0.00175	6	0.0000584	0.20
Chlorine (Residual)						
Maximum	-	-	-	-	0.000146	0.5
Lead						
Average	0.0000876	0.30	0.0000438	0.15	0.0000730	0.25
Maximum	0.000263	0.90	0.000131	0.45	0.000219	0.75
Zinc						
Average	0.00131	4.5	0.0000730	0.25	0.0000876	0.30
Maximum	0.00394	13.5	0.000219	0.75	0.000263	0.90
Flow						
l/kkg		292		292		292
gal/ton		70		70		70

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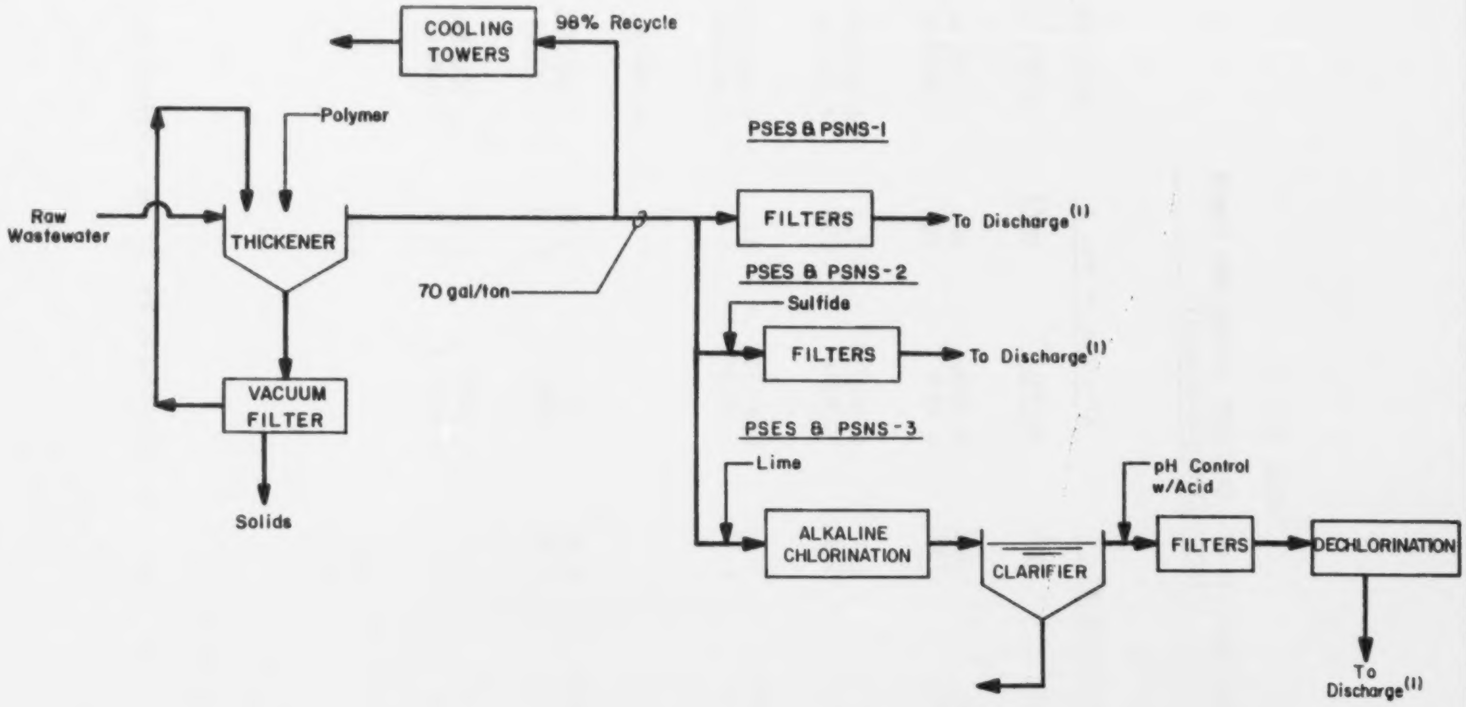
(1) kg/kkg (lb/1000 lb) of product

NOTE: Proposed PSES and PSNS are based upon Alternative No. 3, the selected alternative.


COOLING TOWERS
98% Recycle
Polymer
Raw Wastewater
THICKENER
70 gal/ton
VACUUM FILTER
Solids
PSES & PSNS-1
FILTERS
To Discharge(1)
PSES & PSNS-2
Sulfide
FILTERS
To Discharge(1)
PSES & PSNS-3
Lime
ALKALINE CHLORINATION
CLARIFIER
pH Control w/Acid
FILTERS
DECHLORINATION
To Discharge(1)

(1) Refer to Table XIII-1 for effluent quality and loads.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
PSES & PSNS TREATMENT MODELS

Dwn.5/28/80

FIGURE XIII-1

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